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An Evaluation of the Courses in Elementary Botany as Preparation for Sequent Courses[1]

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THE PROBLEM AND ITS SIGNIFICANCE

A problem of considerable import in the establishment of curricula is the proper allocation of courses in a sequential series. An examination of any college catalog or bulletin reveals that before a given course may be taken certain prerequisites must be satisfied. The implication is that certain information, skills, or other outcomes of training must be attained by the student before he is competent or equipped to pursue advanced courses. Logical as this deduction seems, it may be that some or many courses perpetuate their status as prerequisites by virtue of the early position that they have arbitrarily obtained in a given curriculum rather than through any particular preparatory value which they now possess.

Instead of assuming as axiomatic the claims made for the outcomes of certain courses it would rather appear warranted that these claims should be subjected to evaluation. Even the axioms of Euclid have not always been held sacred. Indeed, the non-Euclidean geometries owe their origin to the time when these axioms were questioned and it was demonstrated that by altering the old Euclidean postulates, new bodies of principles were capable of derivation equally as inherently

1 Paper given at the annual meeting of American Educational Research Association at Atlantic City, Feb. 22, 1930. The study reported is one carried on under the auspices of the University Committee on Educational Research, University of Minnesota. The complete description of this study and others is found in Palmer O. Johnson, "Curricular Problems in Science at the College Level," Minneapolis, Minn., U. of Minn. Press, 1930, 188 p.

consistent as the old. This study, then, is concerned with the evaluation of prerequisite courses. The particular courses chosen for appraisal are those in elementary botany. The specific sequent courses for which these botanical courses are prerequisite are those in the curricula of the divisions of Agriculture and Forestry of the College of Agriculture, Forestry, and Home Economics of the University of Minnesota.

Elementary botany has always been a required course in the Divisions of Agriculture and Forestry. The courses in botany — elementary and advanced — likewise have always been given in the Department of Botany of the College of Science, Literature, and the Arts. As now constituted the curricular requirements for students of Forestry and Agriculture demand nine quarter-credits in elementary botany. For a large number of courses the admission is contingent upon the fulfillment of this requirement. Is this preparatory training necessary? Is the success with which a student may pursue an advanced course dependent upon how well he has been equipped for it in a prerequisite course? These are questions the answers to which are significant. If elementary botany does not fulfill its obligations as a prerequisite course then the justification for its incorporation into the curriculum must rest upon modifications which will make this function possible or upon other values which may accrue aside from those as a prerequisite.

Important as are other considerations which have been given to the solution of the problem, our principal concern in this paper will be limited to a brief discussion of four steps in the procedure:

1. Botany courses — past and present
2. Analyses of preparatory and sequent courses
3. Comparison of achievement in certain courses of students with and without previous training in botany
4. The extent of retention of botanical information.

BOTANY COURSES — PAST AND PRESENT

Procedure: — An inquiry was made into the development of the present elementary and sequent courses. The sources of data were the publications from 1870 to the present time issued by the University of Minnesota pertaining to its curricular organization. (These have been designated as Almanac, Calendar, and Bulletin, respectively.)

The procedure consisted in surveying the courses in botany offered in the College of Science, Literature, and the Arts, noting more especially the allocation of the elementary course; the time devoted to it; the description given in as far as the limitations of a catalog permit; whether it was required or elective; as well as the growth of botany as a science, evidenced by the continuous increase in advanced courses. A similar exploration was made in the College of Agriculture, Forestry, and Home Economics, noting the changing conceptions with respect to the amount of botany, both elementary and advanced, which entered into the curricular organization.

Significant deductions: — Some of the more pertinent findings will be presented.

In the Divisions of Agriculture and Forestry botany has always been considered a basic science. In Agriculture, from a small beginning of seven and one-half quarter credits devoted to elementary botany, the number was gradually increased to twenty-four, then diminished to nine, the number required at present. The median number is twelve for the period 1870-1928. In courses of botany other than elementary, there has been a reduction from a maximum of twenty-four quarter credits as a general requirement to none at present. At the same time, the number of elective credits in botany has ranged from three to twenty-four. Since 1914 the specialization of the student has been the basis for election. In Forestry, the range in required quarter credits of elementary botany for the period 1903-1928 has been from nine to eighteen, with nine the median number. The present requirement is also nine. In courses of botany other than the elementary, the required number of quarter credits has ranged from one and one-half, a general requirement at present, to thirty in certain specialized courses during the period, 1919-21. In elective courses the range has been from fifteen to forty-five, depending upon the specialization of the student.

As the content of the course in elementary botany expanded concomitantly with the increase of time devoted to it, and likewise contracted with the decrease, the emphasis has been placed from time to time on some particular botanical category. These somewhat distinctive elements are to some degree related to the changes in the administrative heads of the department.

Thus, for example, one detects a shift from systematic to physiological botany or from comparative morphology to morphology of flowering plants. Of course, these changes in emphasis may simply register the changes in the development of the science itself. On the whole, however, as far as a general characterization is possible, due to the limitations of a catalogue or bulletin description, it might be said that the course has remained fairly constant in the nature of its content but variable in comprehensiveness and thoroughness of treatment inasmuch as these may be said to be a function of time.

There gradually developed two types of courses in elementary botany, one of which apparently had the primary function of a survey course; the other, the additional function of a prerequisite. These courses finally merged until at present one course exists, which as far as the organization of the curriculum indicates, is designed to have the twofold function — survey and preparatory. Of the two types of elementary courses, the scope of the survey or short course was a general survey of the plant kingdom with emphasis upon the morphology of flowering plants and comparative morphology; that of the preparatory or long course was similar in nature but more comprehensive and detailed in treatment.

In the development of the curriculum a multiplicity of courses have been added. As illustrative of this enormous expansion of the curriculum one might compare its present state in the College of Agriculture with what constituted the sole program of studies in the junior and senior years in 1875. The number of courses has increased from eighteen to two hundred and twenty-two during this interval. This great expansion in the number of courses, many of which are of a distinctly botanical character, renders the functioning of elementary botany as a prerequisite course more and more difficult if it is to lay the foundation for these subsequent courses. The question might well be raised whether it is possible for an elementary course of nine quarter credits to function in this capacity. For with the increase of content within the science itself, the increase in the number of special courses, the reduction in time devoted to the course itself, together with perhaps a reasonable assumption that it has preserved

more the vestiges of its precursors than developed adaptations for the future, it seems fair to assert that the ability of elementary botany to function as a prerequisite in its present state is becoming more and more restricted.

With the expansion of the curricula, the required and elective advanced courses in botany have given way to more specialized courses in the College of Agriculture and Forestry. Together with this expansion, there has resulted specialization on the part of the student. There has been an increase in the number of specialized elementary courses in botany. It might be that these special elementary courses in botany would more nearly satisfy the preparatory function than the elementary course itself.

Analyses of Preparatory and Sequent Courses

The next step in the attack of the problem consisted of the analyses of preparatory and sequent courses.

The Procedure: — Briefly described, the procedure consisted in securing the coöperation of each instructor of the courses under consideration (i.e., four preparatory and twenty-one sequent courses) whereby he prepared a detailed syllabus of his course, in which was given the amount of time devoted to each topic treated. Then from a study of the materials of instruction under each topic, the proportionate distribution of the botanical constituents of the topic to certain defined botanical categories was determined. The primary object of the analysis was to determine the nature of the advanced course, particularly with respect to its botanical constituents; that is, whether or not it might be strictly designated as a botanical course and if so to note into what botanical categories the constituents might be classified; then, by a similar analysis of the elementary courses in botany, to detect whether or not the botanical constituents inherent in these courses fell into categories similar to those involved in the advanced courses. The underlying hypothesis is that the more nearly common the categories are to the elementary and advanced courses, the greater might be the expectancy that the former are preparatory to the latter. For example, if algae are studied in the elementary course but receive no treatment in the advanced courses, the preparatory value of this particular

topic might be considered negligible; on the other hand, if cytology is an ingredient of the elementary course and likewise a constituent of an advanced course, the associations built up around the cell in the former course may be drawn upon in subsequent treatment of the cell in the latter. The transfer value is probably a function of the identity of elements, of a conscious recognition of the fact that experience obtained in one connection is applicable to other connections, or of the application of a certain principle of configuration, according as one accepts the theory of transfer of training as, respectively, enunciated by Thorndike, Judd, and Koffka.

Any system of classification of the content of botany into botanical categories would necessarily result in some overlapping, but the system adopted attempted to reduce this to a minimum. Of considerable import in the validity of the classification is the fact that the instructors of the various courses analyzed are specialists in their respective fields and their training has been largely in botany. Moreover, botany is an old science, dating back perhaps in its modern sense to Conrad Gessner (1516-1565), who was an acute observer and extensive writer, and who stands as the first naturalist of modern times. This antiquity of the science has materially assisted in the standardization of its nomenclature.

Four main botanical categories, further subdivided into twelve minor rubrics, constituted the system of classification into which the botanical constituents were placed. A fifth major category, non-botanical in character, completed the system of classification.

The categories with their respective definitions are:

I. Morphology

1. *Morphology of Flowering Plants.*—The study of the gross structure of one or more typical flowering plants; involves a general knowledge of the essential parts of flowering plants; detailed and microscopic studies of parts are only incidentally included; systematic microscopic studies are under histology and cytology. Gross studies are associated with explanations in terms of functions.

2. *Comparative Morphology.*—An intimate study of the morphology of plants or plant groups in comparison with other plants or plant groups to determine the evidence (macroscopic and microscopic) of the natural relations existing between such plants or plant groups.

3. *Histology.*—A detailed, usually microscopic study of the structure of plants; chiefly a study of tissue elements and tissue systems; studies usually associated with the functions of tissue elements and tissue systems, as well as elements in physical characteristics effecting natural and applied uses.
4. *Cytology.*—A detailed study of the structure and function of plant cells and the essential constituents of the cell, together with their behavior in the various phases of the life of the cell.

II. Physiology and Ecology

5. *Physiology.*—The study of functions in plants; the study of plant behavior as a whole and of individual parts; includes biological, physical, and chemical studies.
6. *Ecology.*—The study of plant behavior in its relation to habitat and environment (includes geology and mineralogy as applied to plants).
7. *Plant Pathology.*—The study of plant diseases; includes the study of abnormal functioning and of morphological variations of the host; the morphological and physiological studies of pathogenes; abnormal functioning due to environmental non-pathogenic causes and remedial measures or measures of control.

III. Taxonomy—the study of the classification of plants.

8. *Taxonomy of Flowering Plants.*—The taxonomy of the spermaphyta.
9. *Algology.*—Primarily a taxonomic study of algae but includes morphological and physiological studies.
10. *Mycology.*—Primarily a taxonomic study of fungi but includes morphological and physiological studies.
11. *Bacteriology.*—Primarily a taxonomic study of bacteria but includes morphological and physiological studies.

IV. Genetics

12. *Genetics.*—The study of biological inheritance and its physical basis; includes studies of control and application in plant breeding.

V. Non-botanical phases

Anything strictly of a non-botanical character, i. e., economics, woodwork technique, geography, surveying, mathematics, physics, or such material inherent in a course of study not concerned with the botanical phases enumerated above.

In most cases the content of the syllabus of a particular course was analyzed by the investigator in conference with the instructor who had prepared it or in conjunction with an authority in the field, and then submitted to the instructor for correction or approval.

Summary and Significance of the Findings: — A summary of the percentage of time devoted to the several categories in the four elementary botany courses and the twenty-one sequent courses in the College of Agriculture and Forestry is presented in tabular form (see Table I). Time permits but a brief consideration of these findings:

TABLE I. *Percentage of Time Devoted to the Several Botanical Categories in Elementary Botany Courses and Sequent Courses in the College of Agriculture and Forestry*

COURSE	Morphology				Physiology and Ecology			Taxonomy				Genetics	Non-Botanical
	Morp Fl Pl	Comp Morp	Hist	Cyt	Phys	Ecol	Pl Path	Tax Fl Pl	Alg	Myc	Bact	Genetics	
Elementary Botany													
General Botany—4-5-6													
Lecture	17	20	15	5	12	6	..	..	9	9	3	4	..
Laboratory	19	19	18	3	21	..	..	..	9	9	2	..	..
Lecture and Laboratory	18	19.5	16.5	4	19.5		..	..	9	9	2.5	2	..
Elementary Ecology—21													
Lecture	..	..	6	..	27	65	..	..	..	5	1.5	..	..
Laboratory	..	..	34	..	13	53	..	..	..	..	..	..	..
Elementary Plant Physiology—22													
Lecture	..	..	..	..	90	10	..	..	..	..	..	..	..
Laboratory	..	..	6	2	73	16	..	..	..	..	3	..	..
Elementary Taxonomy—9a	35	..	1	..	..	3	..	61	..	..	..	..	..
Plant Pathology and Botany													
Plant Pathology—1	..	..	19	..	19		..	..	..	30	7	1	24
Weeds and Grasses—7-8	32	..	..	..	16	8	..	26	..	..	..	..	18
Weeds and Seed Testing—9	42	..	..	..	11	5	..	15	..	..	..	..	27
Horticulture													
Vegetable Growing—32													
Lecture	15	..	..	..	24	13	4	1	..	..	..	10	27
Laboratory	6	..	6	..	26	13	7	9b	..	..	2	12	19
Fruit Growing—6	20	..	..	1	30	15	2	6	..	..	..	3	23
Small Fruit Culture—21	9	..	..	..	21	28	2	9	..	..	..	..	31
Systematic Pomology—111	28	..	..	..	..	..	..	63	..	..	..	..	9
Potato Production—135	8	..	..	..	17	19	8	6	..	..	..	8	34
Agronomy													
Farm Crops—1	25	..	..	..	10	6	4	15	..	..	1	1	38
Grain Crops—121	21	..	..	..	5	9	1	18	..	..	..	3	43
Corn and Potato Crops—122	19	..	..	..	11	16	2	4	..	..	..	7	41
Forage Crops—123	6	..	..	..	5-9-17		3	4	..	..	1	5	50
Principles of Genetics..131	6	..	..	10	..	..	..	..	..	..	..	84	..
Forestry													
Dendrology—3	33	..	..	..	..	5	..	33	..	..	..	..	29
Dendrology—4	33	..	..	..	..	5	..	33	..	..	..	..	29
Silvics—126	..	..	..	..	18	82	..	..	..	..	..	..	..
Silviculture—127	..	..	..	..	..	25	..	..	..	..	..	..	75
Silviculture Laboratory—128	..	..	..	..	35		..	4	..	..	..	..	61
Wood Structure—33	..	..	65	..	..	..	..	15	..	..	..	..	20
Wood Structure..34	..	..	65	..	..	..	..	15	..	..	..	..	20
Forest Mensuration—7-8	2	..	..	..	..	1	..	2	..	..	..	..	95

a — Analysis furnished by Dr. C. O. Rosendahl, Professor of Botany.
b — Leads to standardization.

1. All the sequent courses in the College of Agriculture and Forestry that were analyzed contain botanical constituents but in amounts varying quantitatively and to a certain degree qualitatively. The range in the amount of time devoted to botanical phases is from 5 per cent to 100 per cent. The median amount of time is 69 per cent.
2. None of the twenty-one sequent courses analyzed deals with either comparative morphology or algology and only one with mycology, to which three categories the elementary course in botany devoted 37.5 per cent of its content.
3. When considered as an entity, General Botany 4-5-6 appears to be a well-coördinated course, evidenced by the fact that it gives attention to the several categories proportionate to the significance which is attached to them by the authoritative opinion of botanists (insofar as this is a valid criterion) with the exception of taxonomy of flowering plants and, perhaps, plant pathology. The latter category may be considered quite analogous to mycology, if, in the treatment of fungi, the pathogenic organisms are featured (which is the case as revealed by the analysis). The emphasis placed upon comparative morphology is due mainly to the supposition that a knowledge of it is essential to the complete understanding of the evolution of the flower. The foregoing generalization is, however, more particularly concerned with general botany from the standpoint of its functioning in the preparation of botanists rather than from the point of view with which the problem in hand is concerned; i. e., its functioning as a preparation for sequent courses in the College of Agriculture and Forestry.
4. The four outstanding categories are ecology, taxonomy of flowering plants, morphology of flowering plants, and physiology, when considered from the standpoint of the extent to which they are common to the greatest number of sequent courses. However, another deduction of perhaps greater significance is that diversification in preparatory training dependent upon the subsequent specialization of the student, might be warranted.
5. It appears quite impossible for any elementary course in botany consisting of nine credits to fulfill the demands that might be made upon it by such an array of sequent courses as that revealed by this analysis.

COMPARISON OF ACHIEVEMENT IN CERTAIN COURSES OF STUDENTS WITH AND WITHOUT PREVIOUS TRAINING IN BOTANY

Perhaps the most significant method of determining the effect of previous preparation upon the achievement of students in a sequent course would be to conduct an experiment with two groups of students comparable in all respects, save that one group had had the preparatory course, while the other had not.

There are several limitations placed upon this type of procedure in a university organization. In the first place, students during the first two years in the College of Agriculture

a — Analysis furnished by Dr. C. O. Rosendahl, Professor of Botany.
b — Leads to standardization.

take quite the same course of study; and since botany is not only one of the required courses taken by all students, generally in the freshman year, but also a prerequisite to most of the sequent courses discussed here, it is not possible to secure comparable groups, one with, and the other without previous botanical training. Moreover, the number of students in any given course become less as the advanced courses are reached, so the possibility of securing two comparable groups of significant size presents a problem.

Whereas it was impossible to find conditions in most of the sequent courses where there was a variation in the previous botanical training of the students entering them, due to the fact that botany is a prerequisite to their entrance, nevertheless, in certain courses, viz., Farm Crops 1, Vegetable Growing 32, and Fruit Growing 6, this condition was found to exist. Farm Crops 1 and either the course in Vegetable Growing or Fruit Growing are subjects required of all students in the College of Agriculture, generally in the freshman year. Not all students entering these courses will therefore have had General Botany 4-5-6. This status exists because, due to difficulties in arranging programs of study and variation in the quarter at which matriculation takes place in the University, some students may take these courses in their sophomore year or even later. The same argument holds for General Botany 4-5-6, in that not all students take this course in their freshman year.

It was deemed desirable, therefore, to compare the achievements of students with and without previous preparation in botany in the courses mentioned, since an analysis of their content revealed them to be largely botanical in nature. The basis of comparison was the achievement of the two groups of students — those with and those without botany, on a final objective test given in each course at the time of its completion. A comparison was also made of the relative abilities of students in the two groups on the basis of honor point ratios.

In attempting to account for the lack of significant differences between the achievements of these two groups, an analysis of the course content revealed that in these courses the students are taught the botany deemed necessary for the pursual of the course within the course itself.

Findings: — A summary of the findings follows:

Course	N	Honor Point Ratio	Mean Score With Botany	S. D.	N	Honor Point Ratio	Mean Score Without Botany	S. D.	$\frac{D}{\sigma_{diff.}}$
Farm Crops 1 (fall qt.)	7	.826	86.7	±10.1	9	.878	85.9	±10.5	.15
Farm Crops 1 (winter qt.)	20	1.063	83.9	± 9.03	11	1.022	81.7	± 8.8	.65
Fruit Growing	42	1.226	116.0	±24.6	14	1.368	121.3	±33.3	.47
Vegetable Growing	15	1.558	169.8	±13.2	13	1.603	167.1	±11.8	.73

THE EXTENT OF RETENTION OF BOTANICAL INFORMATION

An additional factor in evaluating the elementary course in botany as a prerequisite to the sequent courses, would be the degree to which the botanical elements were retained; more especially, the extent to which those elements were retained that have a functional value at the time when there is a need for them in the sequent course.

Method and Findings: — There was given during the year 1926-27 a final objective examination at the end of each quarter's work in General Botany 4-5-6. Accordingly, there were three final objective examinations which covered the content of the course. The aggregate of items comprising these tests was 587, of which 265 were of the true-false and 322 of the completion type. A test deduced from this source by the investigator was given at the beginning of the fall quarter of 1927-28, to students upon entrance to the sequent courses. In this way a measure was obtained of the retention for intervals of nine, six, and three months, which had elapsed since the student had completed General Botany 4, 5, and 6, respectively.

The test given consisted of 298 items arranged in order of difficulty. The validity of this test, determined by correlating the scores attained on it by the examinees and their grades in General Botany 4-5-6, was found to be $.87 \pm .02$ ($N = 54$). The reliability as estimated by the Spearman-Brown formula was $.93 \pm .01$.

The botany test was also given to 288 students beginning botany and to two groups of students (29 and 22 in number)

who had completed the course in botany fifteen and twenty-seven months previously.

From the results of this testing program it may be stated that the median freshman entering the course in General Botany 4-5-6 attains a score of 5.5 on the botany test given; this score has been raised to 205 during the progression through the course; then three, fifteen, and twenty-seven months after completing the course the median scores are represented by the measures 110.5; 53, and 49, respectively. The percentage of loss in retention represented by the drop of the median score from 205 to 110.5 is 46.1; from 110.5 to 53, 52.04; and from 53 to 49, 7.5. The rate of loss would, therefore, appear to be quite rapid during the three and fifteen months after completion of the course, followed by a gradual decline afterwards.

A study of the qualitative difference in the nature of the botanical information retained revealed the order of loss in certain botanical categories from the greatest to the least to be as follows: 1, comparative morphology; 2, algology; 3, histology; 4, cytology; 5, mycology; 6, morphology of flowering plants; 7, physiology. The loss is greatest in those botanical categories which do not enter into the content of the sequent courses.

Space prevents a discussion of the technique in which it was shown that there appears to be some relation between the botanical information possessed by the student and his achievement in those sequent courses that are largely botanical in nature.

CONCLUSIONS — IMPLICATIONS AND RECOMMENDATIONS OF THE STUDY

This study has centered around an evaluation of the function of the course in General Botany in preparing students for the pursual of sequent courses in the College of Agriculture and Forestry of the University of Minnesota.

In conclusion it is essential to summarize certain implications of the findings and to make such recommendations as appear warranted.

The implications of the findings tend toward warranting the conclusion that the elementary course in botany has become greatly restricted with respect to its function as a prerequisite

for the sequent courses in the College of Agriculture and Forestry. If this is true of the past, the possibilities of its functioning as a prerequisite in the future are likely to become further and further circumscribed as the number of advanced courses continues to increase and make new demands upon it. A partial recognition of the limitations of the course in elementary botany is manifest in the establishment of such elementary courses as Elementary Ecology, Elementary Plant Physiology, and Taxonomy of Flowering Plants. These courses are an attempt to provide a more systematic and detailed treatment, which the time now devoted to the elementary course makes it impossible to give.

From the analyses of the sequent course and the elementary courses certain facts were established:

1. Most of these sequent courses are really new courses in botany, more specialized, adding large amounts of new material and supplementing the elementary among them.
2. Elementary botany represents certain accretions and deletions from time to time, but the primary forces in this determination have not been the needs of the sequent courses. In fact, the needs of the sequent courses have not been made known to the compilators of the elementary course. The primary concern has probably always been an organization contemplated to prepare prospective botanists.
3. The outstanding categories of emphasis in the sequent courses are ecology, taxonomy, physiology, and morphology of flowering plants.
4. Such categories as comparative morphology, algology, and mycology (except in the case of Plant Pathology 1), to which approximately 37.5 per cent of the content of General Botany 4-5-6 is devoted, apparently have no correlates in the sequent courses.

In addition, data resulting from the study on permanence of learning in botany imply that neither mastery nor any considerable knowledge of the facts is retained by the students.

In view of these deductions certain proposed departures from the established curriculum are presented. The first proposal is concerned with the fundamental desideratum of this study; viz., the prerequisite function of elementary botany for students in the College of Agriculture and Forestry; the second, with values in addition to that of preparation and not limited to any particular group of students.

The first proposal is that in lieu of General Botany 4-5-6, the students in the College of Agriculture and Forestry be permitted to substitute the three elementary courses: Elementary Ecology, Elementary Plant Physiology, and Taxonomy of Flowering Plants. The analyses of these courses revealed

them to be largely concerned with ecology, physiology, and taxonomy, respectively. Morphology of flowering plants enters into each course forming what might be termed connective tissue. These four categories, it has been pointed out, enter most largely into the sequent courses. It appears quite probable that these three elementary courses would enhance the preparation of the student for his subsequent work. This alternate procedure is recommended for appraisal.

The second proposal is that advanced by Dr. Harris[2] and consists of the following arrangement:

1. A four-hour survey course that is a lecture, textbook, demonstration, and class recitation course in the hands of the better instructors. This course is open to the following groups of students:
   A. To all students in the University.
   B. To those students in the University completing the requirement for ten credits in science, provided two of the elementary courses (three credits each) are completed in addition to the four-hour survey course.
   C. To those students in the College of Science, Literature, and the Arts who may elect it but who have already completed their science requirement in some other science, zoology.
2. The election of two of the elementary courses — Elementary Ecology, Taxonomy of Flowering Plants, Elementary Plant Physiology, Elementary Algology, etc. By this election the ten credits in science would be attained. In order to be admitted into these courses the student must have a grade of C in the survey course.

Since this arrangement is provided for all the students of the University, the students in the College of Agriculture and Forestry would then take the four-hour survey course and elect two of the several elementary courses provided. For students entering Forestry, the election of Elementary Ecology and Taxonomy of Flowering Plants would seem advisable; for students specializing in Horticulture, Elementary Plant Physiology and Taxonomy of Flowering Plants; for students in Agronomy, Elementary Ecology and Elementary Plant Physiology; and for students in Plant Pathology, perhaps Elementary Plant Physiology and Elementary Mycology. This plan of reorganization should merit appraisal.

Although this study has been primarily concerned with the evaluation of General Botany 4-5-6 from the standpoint of a prerequisite, there are certain implications arising that might warrant further consideration for the second proposal advanced

2 Head of the Department of Botany, College of Science, Literature and the Arts. This plan of reorganization was adopted at the beginning of the fall quarter of 1928-1929.

above. From data not here reported, it was observed that 39.3 per cent of the individuals enrolled in courses in elementary botany attain a grade of D or below. Of those who complete these courses successfully, not a large percentage become botanists. It appears that these might be factors in determining the content of the survey course. It is suggested that the principal values that might accrue from a course of this nature would be largely appreciation and orientation. If these are desirable values, it would appear that the central theme might be built around the manifold contributions that botany has made to civilization and may make to an intelligent appreciation of one's environment, rather than be concerned with things too much of a technical nature. The technical phases might be left largely to the specialized courses that are preparatory in function.

The plan of reorganization suggested by Dr. Harris is now in operation and this new departure is being evaluated as was the old. Indeed, it is the belief of the writer that the task of evaluating courses in our curriculum should be continuous. If we arrive at the state when final evaluation has been made that would augur failure to progress. Failure to progress merges rapidly into the beginning of decadence.

General Science and Hygiene in the Junior High Schools of Massachusetts

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Our general science textbooks contain considerable material on health and hygiene. The inclusion of hygiene in the general science course was recommended by a national committee of the N. E. A. in Bulletin 1920 No. 26, Reorganization of Science in the Secondary Schools. In the development of the physical education departments in a number of states, hygiene is frequently included as a separate study in the physical education department curriculum. There are, therefore, two sources of influence at work for the study of hygiene in the public schools. It was for the purpose of finding out (1) the status of general science and hygiene, (2) to what extent they are taught jointly and separately in Massachusetts and (3)

what desirable conditions are, that a questionnaire was prepared and sent out to all the junior high school principals in the state.

The data given in this paper were secured from replies to this questionnaire sent out in the fall of 1930. Replies were received from 21 schools having a two-year junior high course and from 132 three-year junior high schools. The general practice in the two-year schools is not materially different from that in the three-year schools and so only the replies from the three-year schools are included in this report.

How much time is given to science? How much time is desirable for science?

TABLE I.—*Total Science Time in Three Years*

	Sum of Minutes in all Three Grades—7, 8 *and* 9						
	0	40-199	200-299	300-399	400-499	500-625	720-900
No. of schools having	4	22	41	46	12	6	1
No. principals suggest time desirable	5	9	23	38	33	8	2

How is the time distributed by grades?

TABLE II.—*Time Now Given to Science by Grades*

	7th grade	8th grade	9th grade
Number of schools having science in this grade	77	94	119
Range—minutes per week	20-285	20-224	40-300
Average—minutes per week	83	91	174

The greatest amount of time given in any one school was a total of 720 minutes distributed as follows: 120 minutes per week in 7th grade; 120 minutes per week in 8th grade; 480 minutes per week in 9th grade. There were 10 schools that gave a total of 480 minutes or more per week during the three years. If evenly distributed over the grades this would give at least 160 minutes a week for each grade. There were 19 schools that gave a total of 400 minutes or more in the three grades. This is divided among the three grades in various ways. In general more time is given to the higher grades as Table II indicates. The highest total time reported as desirable for the three grades was 900 minutes, the equiva-

lent of 300 minutes per week in each of the three grades. Forty-three principals indicated that 400 minutes or more were desirable.

TABLE III.—*Distribution of Science by Grades*
Number of schools in which science is given

In no grade	4	In 7th and 8th grades only	2
In 7th grade only	0	In 7th and 9th grades only	3
In 8th grade only	4	In 8th and 9th grades	19
In 9th grade only	21	In 7th, 8th and 9th grades	79

In 9 of the schools the 9th grade science included in the above table is an elective course. While there is great lack of uniformity in the distribution of science in the three grades, Table III shows that a majority of schools offer it as a sequence in all three grades .

What part of the science work is hygiene? What part should be hygiene?

TABLE IV.—*Hygiene as a Part of the Science Course*

Grade		*Percent of science course which is hygiene* Incidental	0	5-10	15-25	30-60	80-100
7th	Number of schools having	3	29	10	15	16	15
	Principals think desirable	..	31	6	14	22	9
8th	Number of schools having	5	30	10	17	28	5
	Principals think desirable	..	32	8	18	23	0
9th	Number of schools having	3	31	15	24	24	2
	Principals think desirable	..	34	12	30	13	1

About 10% of the courses reported as science are all hygiene in the 7th grade and a few in the 8th and 9th grades are all hygiene. On the other hand 29 seventh grade, 30 eighth grade and 31 ninth grade science courses are reported with no hygiene content. Approximately 40% of the science courses do not include hygiene. Hygiene is a part of the science course in 56 seventh grades and is advocated for this grade by 51 principals. It is included with science in 50 eighth grades and thought desirable there by 49 principals. It is reported in the science work of 51 ninth grades but is desired there by 56 principals.

From estimates given it appears that that part of the science course which is hygiene averages 45% in the 7th grade, 33% in the 8th grade and 24% in the 9th grade. Averaging the percents of science time reported as desirable for hygiene gives this result: 44% in the 7th; 42% in the 8th; and 23% in the 9th grade.

Should there be separate courses in hygiene?

Outside of the science course hygiene was reported as being taught in correlation with civics, health, foods, home economics, domestic science, gym and physical education. The larger number report it as given under the physical education department as a separate course.

TABLE V.—*Time given to Hygiene in Separate Course*

Minutes per week:	0	15-20	30-40	45-60	80-120	150-280
No. of 7th grades....	39	6	25	20	8	2
No. of 8th grades....	46	7	28	14	3	1
No. of 9th grades....	52	6	20	13	2	1

In 38 schools no hygiene was taught in any of the three grades. In 65 schools hygiene was offered as a course separate from science. The vote for placement was as follows: 30 for 7th grade only; 10 for 8th grade only; 4 for 9th only; 20 for 7th and 8th grades; 3 for 7th and 9th and 20 for 7th, 8th and 9th grades. From these figures it appears that hygiene is suggested for the 7th grade by 70 principals, for the 8th by 60 and for the 9th by 27. No one favored a course in hygiene in place of general science but 72 are recorded in favor of hygiene in addition to general science.

In Massachusetts normal schools hygiene is taught in the physical education department. The teachers in the public schools have the physical education background for hygiene rather than that of science. There is a state law which requires a certain amount of hygiene to be taught in the elementary schools. These facts might be expected to lead to more separate courses in hygiene than are found in actual practice. There seems to be no strong opinions favoring the inclusion of hygiene in the science course or of separation from it. One plan satisfies one group while the other plan satisfied another.

In conclusion, the junior high school principals would give general science more time than it now has and they favor its running consecutively through the 7th, 8th and 9th grades with increasing amounts of time in the higher grades. One group is satisfied to have the hygiene included in the general science, but a larger group, while not objecting to its being in general science, desire hygiene courses separate from the science or in addition to that given in the science course.

Science Interests of Junior-High School Pupils

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The possibility of using pupil interests as a fundamental criterion in making the science course of study has been stated many times and a number of studies have been made to discover the interests of pupils in the various high school grades. The studies of Pollock[1] and of Curtis[2] are particularly interesting. The course-of-study worker should examine the findings of these studies before he arrives at a final decision regarding the disposition of a given science topic. Few would wish to use children's interests as the sole criterion for the selection of subject-matter content, but undoubtedly these interests should be the starting point from which the course may proceed. If it were to be discovered, for example, that ninth grade pupils in a given city or region are more interested in aviation than in any other science topic, may not the study commence with a discussion of airplanes and aviation in general? Should not the expert teacher find out what the pupils actually know about the subject, why they have their interest, and what aspects of flying are really interesting? Do the pupils want to know why and how the airplane stays in the air, or are they chiefly interested in the romantic, emotional aspects of flying? Are they at all anxious to learn about airplane and motor design, or do they want merely to be thrilled by taking a ride through the air? Similar analyses should be made of other interests, and let it be said that the interests should be directed by the skillful teacher into the worthwhile aspects of the subject from the point of view of interpreting scientifically the environment.

There is the question of the variation of interests in the two sexes. Do boys like the same things that girls are interested in? Pollock found in his study that there was considerable overlapping of interests. It was discovered, however, that

1 Pollock, C. A. Children's Interest as a Basis of What to Teach in Science. "Ohio State Univ. Educ. Rs. Bulletin," Jan. 9, 1924. Vol. III, No. 1.

2 Curtis, F. O. Some Values Derived from Extensive Reading of General Science. "Teachers' College Contributions to Education," No. 163, 1924.

boys are more interested in certain subjects than girls, and girls have interests in certain other subjects that boys apparently do not have. As a result of his findings, Pollock makes the suggestion that "in the science course, as elsewhere, provision should be made, as far as practicable, for sex differences." Should not other questions be raised regarding the differences in interests of our pupils? In this day of classification into homogeneous sections on the basis of mental ability, shall not the course-of-study worker try to provide adequate materials for the several levels of mental ability? Have we done our best unless we have tried to discover the needs and interests of the several groups and to secure the proper subject-matter if differences are indicated? Classification into relatively homogeneous groups is an important procedure in making possible the best use of our pupils' abilities. But classification is a device and can only point out that there are further problems to solve. Shall we not try to gain some insight by ascertaining the differences in the expressed interests of the several groups or classifications of pupils?

One of the problems undertaken in Los Angeles during the past year has been that of attempting to discover the interests of pupils at the present time. We have been anxious to discover whether there have been any important shifts in interests since the studies of Pollock and of Curtis several years ago. With the tremendous general interest in aviation, we felt sure that we should find at least one difference. One course-of-study committee sought from junior high school pupils their general interests. In this case no clues were given as to what interests were considered important by the teacher. This study showed that boys are very much interested in science topics, while girls are more interested in the arts. Another study was undertaken by a teacher in one of the Los Angeles junior high schools. The writer is indebted to this teacher, Mr. J. R. Livengood, for the raw data from part of his study. From these data the writer has prepared the tables that follow and the comments. Mr. Livengood prepared the following questionnaires which were submitted to junior-high-school pupils. It will be noted that an earnest attempt was made to suggest as little as possible to the pupils.

To Pupils of the A-7th Grade:

You will be entering a science class next semester. There you

will have an opportunity to have many questions answered that have been puzzling you. Science teaches us about the sky and the earth. It tells just what things are used to manufacture many things people need. Science explains how everything grows and how to build up and take care of our bodies. In science, we study how goods, people, and messages are carried on land, sea, and in the air. It also tells how our homes and lives are made more comfortable. Science teachers are anxious to tell children about all of these wonders. They want to tell you about things that interest you. Will you write down five different things in science that you would like to learn. Write one after each number below.

To Pupils of the A-8th Grade:

You have by this time had some experience with the study of science. You know that it helps you to understand the things that you never understood before. Perhaps many things you wanted to know were explained and others were not. Next year you may choose general science and learn more of the wonders of this subject. To enable you better to understand the things in science, the teachers are asking you for a list of science topics that you are interested in. Will you think over carefully the various things science tells about and write down the five you think most interesting, after the numbers listed below.

To Students of A-9 General Science:

You have by this time advanced far enough in the study of science to know many of its fields, and have no doubt formed an opinion of which kind you like best. In order that the teachers of science may be most helpful to you, they desire to know what boys and girls of your age find most interesting. To determine this you are each asked to make a list of no more than five things relating to science in which you are really most interested. Write one of the five topics you select after each number listed below.

The pupils were asked to give their grade, age and sex, but not their names. Space was also provided for the teachers to indicate whether the class was composed of superior, average, or inferior pupils from the standard of mental ability. Not all pupils, of course, were able to express five interests. From the 1067 papers returned, 178 different scientific interests were tabulated. For the purposes of this study this large number of interests was condensed into the much smaller number shown in the tables.

Table I shows the science interests of the three classifications of junior high school pupils, superior, average, and inferior (based for the most part on the results of mental tests). The actual numbers involved in each classification were as follows: Girls, inferior 155, average 157, superior 219; boys, inferior 143, average 194, superior 199. In view of the differences in numbers involved, and rather than reduce all to a percentage basis, the number of superior girls was equated to the numbers of the other groups of girls. The same was done for the inferior groups of boys. The numbers cannot, therefore, be

compared as between the sexes, but may be compared directly for groups within each sex.

TABLE I. *Interests of Junior-High-School Pupils.*

SUBJECT	*Girls*			*Boys*		
	Inferior	Average	Superior	Inferior	Average	Superior
Astronomy, general	25	71	43	41	48	58
Stars	49	38	61	18	25	22
Planets	5	5	16	19	17—	22
Moon, Tides, etc.	7	16	9	7	21	15
Earth	36	22	21	49	32	21
Sun	5	8	5	4	13	7
Comets	0	3	1	1	0	4
Sky	20	12	13	33	16	12
Navigation	0	1	0	1	8	5
Weather and Climate	11	5	6	11	10	6
Precipitation	12	5	8	1	0	2
Clouds and Fog	3	2	1	1	0	1
Air currents	9	8	13	24	16	25
Storms	5	1	8	0	0	1
Biology, general	9	11	8	14	13	22
Botany, general	5	20	11	11	10	15
Flowers	27	31	19	11	6	8
Forests	18	14	18	10	8	4
Plants	56	47	48	28	17	26
Seeds	2	1	1	0	0	1
Nature Study	5	7	3	6	2	2
Chemistry, general	20	43	31	60	82	84
Atoms and molecules	0	0	0	3	2	2
Acids, bases, salts	1	0	1	3	1	1
Elements	5	4	6	13	0	9
Chemicals	1	0	1	6	2	9
Photography	0	0	0	1	4	0
Physics, general	2	6	5	8	15	18
Aviation	12	23	18	42	45	73
Electricity	27	9	18	47	43	48
Automobiles	1	3	3	3	11	3
Forces	5	7	5	10	18	6
Heat and fire	0	7	7	14	4	6
Light	5	3	1	7	8	6
Radio, television	7	3	15	32	26	31
Moving pictures	4	0	5	6	0	5
Sound	1	0	2	0	1	5
Telephone	6	0	7	3	3	11
Color	2	0	1	3	1	1
Vibrations	0	1	6	0	0	1
Mechanics	5	7	7	22	34	25
Geology, general	4	21	11	18	16	22
Minerals and rocks	14	17	17	26	28	20
Oceans and rivers	13	6	10	17	9	6
Earthquakes	7	1	12	0	1	6
Metals	0	0	1	7	7	2
Physiology, general	3	11	8	6	9	8
Hygiene, health	15	4	3	3	0	2
Human body	43	29	26	22	19	19
Parts of body	4	3	7	3	1	6
Zoology, general	0	15	12	15	20	23

SUBJECT	*Girls*			*Boys*		
	Inferior	Average	Superior	Inferior	Average	Superior
Animals	60	68	57	46	42	43
Birds	28	3	13	20	10	14
Fish	15	2	6	8	14	12
Insects	38	24	31	19	35	27
Reptiles	1	1	3	0	2	5
Mammals	5	2	0	4	3	0
Other classes	1	2	2	0	1	8
Agriculture	4	5	3	14	8	3
Archaeology	2	3	4	1	4	5
Transportation	0	3	0	7	4	4
Inventions	0	5	3	13	6	9

A general examination of the above table is very interesting. The one who would seek significant differences meets with difficulty. Science teachers interested in certain special phases of science often like to believe that their subject is strictly for the superior. Perhaps such a statement is true when one considers the methods of instruction used by those certain teachers. The table does show one or two instances of progressive change from one group to another. For example, astronomy for the boys gives these figures 41, 48, 58. Earth, under astronomy, gives a different picture: boys 49, 32, 21; girls 36, 22, 21. In the case of astronomy, apparently the bright boys have more interest than the duller ones, with the average in the middle. On the other hand, astronomical aspects of the earth seems to interest the inferior pupils more than the superior ones, with the average pupils again in the middle. If we look through the tables for this progressive increase or decrease, we find very few instances of significant differences. And these progressive changes are found more often in the case of boys than of girls. If the interests of inferior and of superior pupils are compared, omitting consideration of the average pupils, perhaps some significant statements can be made. Thus the interests of the two groups of girls in astronomy, stars, planets, earth, weather, flowers, chemistry, radio, geology, hygiene, human body, zoology, birds, fish show appreciable differences. The same might be said for moon, earth, sky, weather, biology, chemistry, physics, aviation, telephone, oceans, insects, and agriculture in the case of the two groups of boys.

In order to get the chief interests of the several groups in mind, Tables II and III have been prepared. These tables show the first fifteen interests of each group of boys and girls respectively.

TABLE II. *Rank of Interests of Boys.*

Interests	*Inferior*	*Average*	*Superior*
Chemistry	1	1	1
Earth	2	7	15
Electricity	3	5	4
Animals	4	3	5
Aviation	5	4	2
Astronomy	6	2	3
Sky	7	0	0
Radio	8	8.5	6
Plants	9	0	7.5
Minerals	10	8.5	7.5
Air	11	0	9.5
Mechanics	12.5	6	9.5
Human Body	12.5	11	12.5
Birds	14	13	0
Stars	0	10	12.5
Moon	0	12	0
Insects	0	14	0
Planets	0	0	12.5
Biology	0	0	12.5

TABLE III. *Rank of Interests of Girls.*

Interests	*Inferior*	*Average*	*Superior*
Animals	1	2	2
Plants	2	3	3
Stars	3	5	1
Human Body	4	7	6
Insects	5	8	4.5
Earth	6	10	7
Birds	7	0	0
Flowers	8.5	6	8
Electricity	8.5	0	10
Astronomy	10	1	0
Sky	11.5	0	0
Chemistry	11.5	4	4.5
Forests	13	0	0
Hygiene	14.5	0	0
Fish	14.5	0	0
Aviation	0	9	10
Geology	0	11	0
Botany	0	12	0
Minerals	0	13	12
Moon	0	14	0
Zoology	0	15	0
Forests	0	0	10
Planets	0	0	13
Radio	0	0	14

It is immediately evident that there are real differences in interests of the several groups of boys and of girls. The believer in interests as a criterion for course-of-study material should make allowances for these differences. Can we say with Pollock "Let the Children's Interest List direct the way? Have the text which contributes most to the interests of the pupils in the foreground and use for references the others which have stressed and developed the special environment. Supplement these with carefully selected readings and references." Or shall we have to admit that the interests of the sexes are different, and that the interests of pupils of varying mental abilities are different, and therefore proceed somewhat differently?

The writer believes that worthwhile study of pupils' interests should be comprehensive enough to determine whatever differences may exist among groups of pupils. A much larger number of responses is needed than were received by Pollock, Curtis, or the present writer. Doubtless other studies should be made upon the basis of the information gleaned from the first questionnaire. Perhaps the first questionnaire has not reached adequately certain types of pupils in certain situations. The second study might well call for check-lists, upon which the pupils may indicate their keenest interests. Possibly a number of such check-lists should be prepared, so that the pupils who are to react may not be required to keep in mind too many topics. The point is that the interest studies which have been made and published to date are excellent beginnings for future additional necessary studies. It is the hope that this study will add something to what is already known about the science interests of pupils of the junior high school age.

Conservation

God has lent us the earth for our life. It is a great entail. It belongs as much to those who come after us as to us and we have no right by anything we do or neglect, to involve them in any unnecessary penalties, or to deprive them of the benefit which was in our power to bequeath.—*Ruskin.*

The Introductory Biological Sciences in the Traditional Liberal Arts College*

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About two years ago the head of the division of Higher Education of the Office of Education declared that from a professional viewpoint the poorest teaching in the whole educational system was to be found in colleges. It is difficult to believe that such a declaration of opinion would emanate from an official source of such importance unless it could be substantiated. The statement was surely not intended to be applied to any particular department of subject matter or to include the few unusual teachers who are undisputed leaders in the teaching of their respective subjects. It was no doubt intended as an indictment of the teaching of that hypothetical individual, "the average college teacher," engaged in instructing undergraduate students in the well-established liberal arts courses.

In this paper an attempt will be made to discover the evidence for and against the assertion, in so far as it is applicable to the introductory biological sciences. It will be limited further to an examination of the objectives of biology instruction and a study of the extent to which these objectives are actually realized in instruction. This limitation is more apparent than real, for the objectives of instruction are very intimately related to the selection of subject matter, emphasis in instruction, and actual teaching practices.

Let us first examine the objectives of instruction in the introductory biological sciences for adequacy and validity. It is evident from the history of biology instruction that the objectives of teaching have been influenced periodically by the changing trends and fashions in the science of biology itself. The professional biologist, rather than the educator, has up to the present time been very prominent in determining what shall be introduced into and retained in biology courses. This situation has arisen from the fact that the head of the biology department in most colleges has been first of all a professional

* Reported at the Detroit Meeting of the Association for Research in Science Education, February, 1931.

biologist, keenly interested in biological research, and secondly a teacher. It is almost inevitable that the logical association of subject matter according to the strict regimen of science, rather than the selection of subject matter on the basis of broad educational values, should be uppermost in his mind. While the value of such a strictly scientific organization and selection of subject matter is acknowledged, and courses for embryo biologists should undoubtedly be organized along such lines there is considerable doubt that this procedure is the best one for the great body of students entering their first and, unfortunately, too often their last course in biological science.

Those who subscribe to this professional biological point of view usually do admit and recognize the educational values that are inherent in the biology subject matter but somehow in actual instruction they often lose sight of these values and hope that the student will become conscious of them by his own efforts. Frequently under such conditions biological science becomes an end in itself, instead of a means to an end. Technical verbiage, minute, unrelated, and ready-made facts absorb the exclusive attention of the beginner instead of the significant interpretations which might reasonably be expected to be derived from this level of educational instruction.

In consideration of these conflicting viewpoints towards biology instruction an evaluation of the objectives of biology teaching must be made in terms of the major purposes of college education rather than provincial departmental standards. The goals of college instruction vary according to local conditions and divergent educational viewpoints, but in general, preparation for a liberal education, whatever that may signify, seems to be one of the most widely accepted major aims.

The meaning of a liberal education has been a subject of frequent discussion. John Dewey, James H. Robinson, E. D. Martin and many others have assisted in clarifying the present definition of the term. As a result of their analysis and that of a great many other educational authorities it has been possible to isolate some of the important subsidiary objectives which may contribute to a liberal education. Briefly, a liberal education endeavors:

1. To provide a knowledge of the great and fundamental truths of nature.
2. To apply learning towards constructive purposes.
3. To develop scientific attitudes of thought.

4. To develop scientific methods of thought.
5. To develop creativeness.
6. To consider the needs of society as well as those of the individual.
7. To develop the mind in a harmonious fashion instead of giving attention exclusively to just one or two of the above objectives.

The limitations of this short list are acknowledged. It is nevertheless true that it probably contains the more important elements in a liberal education as the term is understood today.

Let us now attempt to evaluate the objectives of biology instruction, so prominently advertised in departmental announcements in college catalogs and in the prefaces of biology textbooks, to determine whether they are directed towards the liberal education we have just defined. One hundred college catalogs and twenty-one widely used college textbooks were examined and the present objectives of biology instruction were derived therefrom. The following objectives of biology instruction are mentioned frequently:

1. To give information about fundamental facts, principles or essentials of the science of life, including the study of structure, physiology, ecology, classification, etc. 131 times.
2. To survey the plant and animal kingdoms or to study types in detail. 54 times.
3. To show the relation of plants or animals to our welfare, or to show their economic importance. 20 times.
4. To acquaint the student with the various theories of the biological sciences. 12 times.
5. To provide a cultural course, to emphasize the philosophical aspects of the subject. 10 times.
6. To train the student in the use of scientific methods as applied to biological science. 8 times.
7. To prepare the student for other related courses. 4 times.

Comparison of the objectives of instruction stressed in biological courses (that is, in textbooks and course announcements) with the desirable objectives of instruction which are closely related to a liberal education, reveals several striking differences. In actual practice, attention is almost exclusively directed towards one of the objectives: namely, the acquisition of a knowledge of the great and fundamental truths of nature. Out of the two hundred and thirty-nine objectives of teaching mentioned in the departmental announcements, more than two hundred are directed towards this informational objective. The present objectives of instruction are not fully in line with the larger purposes of college instruction for they give too much attention to one objective and practically none to many of the other desirable objectives which contribute to a liberal

education. The development of a scientific attitude of mind and the acquisition of skill in employing the scientific methods are scarcely considered in introductory biology courses. Only eight out of two hundred and thirty-nine objectives of instruction are devoted to an understanding of scientific methods, as applied to biological science. Some teachers may contend that mastery of the facts of biological science is such an important factor in a liberal education that it should receive much more attention than any other objective. The mastery of the fact and principles of biological science is indeed very important for the perceptions of science are the bases from which the broader generalizations are derived. While it is not denied that mastery of the facts of the science, as for example, the professional biologist masters them, should not be the sole objective of biology teaching, it is nevertheless true that a knowledge of the basic facts and principles is essential to a liberal education. But only a limited number of facts should be introduced to the beginning student, and these should be thoroughly mastered. Actual examination of the informational outcomes derived by students taking introductory biological courses, in which informational objectives were stressed almost entirely, gives the following interesting result. Less than fifty per cent of the students succeeded in mastering as many as half of the informational elements of the course, a knowledge of which could be expected from every liberally educated student. This finding seems to invalidate the present tendency to consider only the informational objectives in instruction "because the subject matter is the most important thing to be learned." The group of students now enrolled in our colleges is apparently not able to digest all the facts now included in these introductory courses.

Teachers overlook an important aspect of biology instruction when they fail to make the student understand that science is method as well as subject matter. Biology in colleges has suffered because it has frequently been presented just as so much ready-made knowledge, so much subject matter of fact and law, rather than as an experience with an effective method of inquiry into any subject matter. Science means both systematized knowledge and the processes by which the body of new knowledge has been brought into existence. While instruction in the introductory biological sciences can hardly be

expected to send forth students equipped as judges of truth and falsity in specialized scientific matters, they may at least be expected to give him some idea of the kind of evidence required to substantiate certain types of belief. The need for such instruction was certainly shown by the disgraceful circus at Tennessee in 1926, at which time millions of our population expressed hostility to the method of science and open distrust of the integrity of scientists and disbelief in the validity of scientific methods. Biology instruction should surely prepare all college men to understand and impart to others this broader meaning of scientific endeavor.

Let us now turn from the objectives of instruction to the subject matter of introductory biological science. A file of final examination questions extending over a period of several years was obtained from each of sixty-three colleges. The three thousand or more questions were classified so that they might reveal the present emphasis in instruction. In addition certain interesting facts concerning examination practices were brought to light. Out of a total of seventy-one departments of Botany, Zoology, and General Biology, fifty-one employed the essay type of examination exclusively, seven the objective type of examination and thirteen both types. Each of the three thousand examination questions was classed as an information or thought question with the result that only ten per cent of all the questions seemed to fall into this category. A very liberal criterion was employed in classifying the questions so that if the classification was unfair it operated to increase the per cent of thought questions. In consideration of the fact that the final examinations dealt almost exclusively with information, it seems that the objective type of examination would have been a more satisfactory tool than present examination procedure would indicate.

The definitions which students in introductory biological science were expected to explain included eight hundred and forty-nine different terms. Students are thus expected to master a vocabulary equal to that of a foreign language, as well as mastering the facts and principles of the science. In order to determine the extent to which these terms were unique to college biology the vocabulary studies of Ruch-Cossmann, S. R. Powers and F. D. Curtis were consulted so that the frequency of the terms in high school biology texts and other

sources might be evaluated. Each college definition in biology was finally given a value according to its relative importance in six sources.

Another study, related to the major problem, was the determination of the relation of extra-classroom biology to the biology of the college classroom. This was to give an indication of the extent to which students come into contact with biological information in periodical literature, newspapers and popular books on biological subjects. It was found that a very limited number come into contact with periodicals which contain much biological science. An analysis of a file of seventeen newspapers for a period of a month revealed that the emphasis in newspaper biology has changed from that reported by Finley and Caldwell in 1921. While twenty-nine per cent of the biological articles related to health in 1921, they constituted about forty per cent in 1928. Evolution, which was discussed in one and a half per cent of the biology articles in 1921 was treated in four and four-tenths per cent in 1928. One of the most significant findings was the disclosure of the extent to which students, who had just completed a course in college biology had read "Popular Books on Biology." The Library of the institution investigated contained each of one hundred titles, all of which could be borrowed for home use. About ninety per cent of the students readily admitted that they did not know of the existence of about seventy-five of the titles, although they were all easily available. This is certainly a poor showing for an institution which presumably is endeavoring to give its students a liberal education. The books read most frequently (by twenty-five per cent of the students) were Dorsey, *Why We Behave Like Human Beings,* and DeKruif, *Microbe Hunters.* Slossons' *Keeping Up with Science* and *Chats on Science* were read by about ten per cent of the students.

Another important finding in this part of the study was the fact that students do not engage in biological hobbies except to a very limited extent. Biological courses should be exploratory to a certain extent, permitting students to come into contact with many of these experiences during the formal course. Otherwise, it is improbable that they will ever become attached to any of the worthwhile and enjoyable biological hobbies.

The last step in the investigation was the construction and administration of tests to determine what outcomes were derived from introductory courses in the biological sciences. These tests were derived from the source material obtained in the analysis of final examinations questions, college textbooks, newspapers and periodical biology. A series of comprehensive objective tests containing twelve hundred different items was constructed. About sixty per cent of the test consisted of the basic biological science frequently included on final examination and also present in most standard texts. The other forty per cent consisted of a broad range of biological information. The reliability of the four forms of the test was .93, .89, .93, .95 respectively for groups of about one hundred students, drawn from seven different colleges. About 632 items on this test — fifty per cent of the field of biological science represented on the test — were mastered by about one-half of the students. This can hardly be considered successful attainment of the leading objective in the teaching of biological science — "a knowledge of the facts and principles of the science."

Little Journeys at Home—A Science Project

J. N. TAYLOR, Washington, D. C.

The use of statistics as a basis in teaching science classes does not upon first thought appear to have a great deal in its favor. To some, statistical data are just so many dead, dull figures, useful only for post mortems. To others, however, they present pages of glorious history or point the way to further endeavor, and to yet others they open up a region of romance where the "valley of dry bones" becomes quickened when breathed upon by the spirit of imagination.

Statistical Data as Motivating Influences.

Our progress in foreign trade, as revealed in statistical tabulations, is an achievement of which to be justly proud. To scan an export table and trace therein our growth in commerce and trade, to trace our outbound shipments to the four quarters of the earth is indeed thrilling.

Equally interesting and instructive—if not more so—is a

study of our imports by countries of origin or shipment, especially to persons who like to go to places and see things. And what student does not?

Statistical data may be used by the science teacher as an effective method of approach in setting forth important truths and in teaching a number of apparently unrelated sciences. The perusal of a list of imports of crude botanical drugs examined by the Federal Food and Drug Administration and reported by Mr. W. M. R. Wharton, Chief of the Eastern District (famed for his "Read the Label" radio talks) may seem to be prosaic reading. But such a list may serve as the basis for the discussion of an important industry—the grading and conditioning of crude drugs. Or it may call forth visions of battles between life and death where the strength and potency of drugs is absolutely necessary. A class period could well be devoted to a discussion of the improvement of public health as a result of modern medical and chemical discoveries and the importance of having, in times of emergencies, remedies that can be relied upon. This would also present an excellent opportunity to call attention to the inestimable benefits that have accrued to the public as a result of the rigid inspection service carried on by our Food and Drug officials. Cinchona, the source of quinine; aloes, from which is obtained aloin; ephedra (Ma Huang), the source of ephedrine; nux vomica, from which is derived strychnine—these and many other plant materials are carefully inspected in Government laboratories before entering trade channels.

Utility of Mr. Wharton's List in Teaching Geography and Botany.

The import list can also be made the basis for a most interesting geography-botany project through the travel appeal. What are the origins of these products that find their way to our shores?—where do they come from and from what raw materials are they produced? Such a list of commodities envisions scenes of strange and far-away places as fascinating as any described in "Trader Horn," or Wright's "Great Horn Spoon," and a study of them connotes many important economic facts.

Let us take the boys and girls on a little journey—giving to each one as a project the definite job of developing information regarding one commodity. John may take acacia, the first on

the list, Mary may have cinchona, and so on. I have always wanted to go to China, so I shall endeavor to get some information about Ma Huang—a drug, not a game.

Instead of being transported to the Far East on a magic carpet, let us go by vessel taking the opportunity enroute to observe in brief outline some outstanding features of geography and economics.

We Start on Our Journey.

And now, with all the allurements of a long ocean voyage to the Flowery Kingdom and armed with our trusty list and a good atlas we set forth on our voyage of discovery to foreign climes. Since, to quote Mr. Wharton, practically all crude drugs that come to the United States are entered at Eastern District ports we shall sail from the Port of New York. Stopping in New York City only long enough to get our passports and with only a glance at the Custom House with its intriguing intricacies of import procedure, or at the busy scenes at the appraisers' stores, the testing laboratories and the warehouses and docks piled high with casks, kegs, seroons, dhools and pynchons, we board our ship chartered especially for the occasion.

Carrying with us a cargo of manufactured goods we drop down past the Statue of Liberty, out through the Narrows and onto the broad Atlantic. Although many of our exotics come to us from dealers in London and Liverpool or from the transshipment ports of Hamburg, Marseilles and Trieste we shall not stop in Europe, but passing Gibraltar enter the blue Mediterranean and make Alexandria our first port of call. Here John may gather material for his project with acacia and taking advantage of the stop-over necessary to discharge portions of the cargo destined for Cairo and other points in Egypt, may call at the American Consulate where he will be assisted in assembling necessary data. The khordofan acacia, or Arabian gum, said to be a superior variety of gum arabic is shipped from Alexandria as are also senna, fenugreek, henbane, caraway, cumin and coriander.

Continuing on our journey, we go through the Suez Canal into the Red Sea and as we pass the Island of Socotra in the Straits of Bab-el-Mandeb, we are reminded of yet another of the materials on Mr. Wharton's list — aloes. The history

geography and botany of the several varieties of aloes would make an excellent thesis for some member of the class, necessitating "little-journeys-at-home" to southern Africa and the Netherlands West Indies.

A Glimpse of the Tropics.

Rounding India with her gigantic Himalayas and vast desert plains, passing Ceylon, the "Pearl of the Indian Ocean," hanging in pendant fashion from the tip of the Indian Peninsula we approach the Netherlands East Indies, which include Java, Sumatra, Borneo, the Celebes, the Molucca Islands, the Smaller Sunda Islands, and thousands of minor islands. Java, it will be explained to Mary to whom was assigned cinchona, is the main source for the markets of the world of this important commodity. She will find the study of cinchona a most fascinating one, tracing its vicissitudes throughout more than half a century from the mountain wilds of Peru to the cultivated regions of British India, Ceylon and Java.

Sailing northward we soon come within view of Singapore, the seventh port of the world — the "Gateway to the East." Located on an island off the southernmost tip of the Malay Peninsula, its excellent harbor attracts all kinds of shipping and makes it a foremost shipping and trans-shipment port. It is a veritable hub for the commerce of near-by islands, Borneo, parts of the Netherlands East Indies and Siam and serves as the shipping point for many commodities. Among outgoing shipments may be found quills of cinnamon bark, bottles of cajeput and citronella oils, clove stalks and cases of mace, nutmegs, cubebs, ginger, pepper, rhubarb, areca nuts, fish berries, derris, catechu, benzoin and other gums and balsams.

Entering now the China Sea "where the flyin' fishes play" we continue our course toward Shanghai, where I shall endeavor to gather material bearing upon ephedra together with some data regarding its habitat.

To "China 'Crost the Bay."

As we continue northward, keeping well inshore, we note with interest after passing the 18th parallel, the outline and physiography of this ancient and mysterious land. With the

aid of our atlas and travelers' guide we learn that with the exception of the area comprising the great central plain formed by the valleys of the Yellow and Yangtze Rivers, the topography of China proper is mountainous or hilly. Climatically, China enjoys two distinct seasons, summer and winter, with short Autumn and Spring seasons. Its total area is estimated at between 4,278,000 and 4,376,000 square miles and its population is estimated to be 435,000,000. "The great majority of the population is found in China proper and there are large areas in the north and northwest that are sparsely settled. There are some 60 peoples or tribes found in China, though most of the population belong to the Mongol-Tartar race and speak a common language (Chinese). The small tribes in the South and Southwest of different race are related to the Siamese and Burmese."

Shanghai, the Paris of the Far East.

We have now traveled over 12,000 miles and are approaching our destination. Entering the estuary of the Yangtze, we thread our way among the gaily painted junks of the Whangpoo and finally arrive at Shanghai. This city is the commercial metropolis of China. Much of the cargo entering this port is re-exported to other large trade centers in the interior along the Yangtze and up and down the coast. It is also the most important consuming center of Western products in the Far East. Consequently, in Shanghai are located the principal foreign import and export houses doing business in China and its annual foreign trade is extensive, including hundreds of commodities. Just at present we are interested in but one — our Ma Huang (Ephedra) — consequently, we shall seek the assistance of the American Consul General and the American Trade Commissioner in assembling our data. Thanks to these gentlemen and also to Dr. Bernard E. Read of the Peiping Medical College we learn that Ma Huang reaches Shanghai in native bags weighing about three piculs (400 pounds) each and is repacked for shipment. Known as Ma Huang in China and Ma O in Japan, Ephedra has been used for centuries in Chinese medicine dating from the time of Shen Nung, B. C. 2852. It was held in such high repute that during the Ming dynasty it was accepted as tribute. Ma Huang is a common plant in north China and Mongolia. It

bears yellow flowers, and produces red, edible berries, which have been likened to the raspberry. Pistillate and staminate flowers are borne on different plants.

Ma Huang is harvested in the fall of the year, being pulled from the ground by hand, after which it is packed in rough native bundles for transport to collecting and consuming centers, where it is prepared for export. It occurs upon the market usually as a whole plant, 10 to 12 inches long, including the root, looking like bundles of grass, for it has no leaves upon its stems except very tiny little bracts. Again, states Dr. Read, it may occur upon the market in the form of chopped stems about half an inch long, and one-sixteenth to one-tenth of an inch thick. In some cases for convenience of transport it is finely powdered and packed in large flour bags. For this purpose the roots are discarded and in the case of woody Ma Huang the woody branches also must be discarded.

There are three species of *Ephedra* occurring upon the market as Ma Huang. The most reliable is *Ephedra sinica,* which together with *Ephedra equisetina,* grows in great abundance along the T'ai-hong-shan mountains, which follow along the Great Wall of China in Chihli, Shansi, Shensi, Kansu, Jehol, Chahar, Suiyuan, Honan and Hupeh. The area covered is like a letter T and is defined by its terminations in the two Kuans and the two Kous, Shan-hai-Kuan, Chia-yu-Kuan, Chang-chia-kou, and Hankow. A third species, *Ephedra distachya,* grows on the Southern arm of the T, from Shansi down to Honan and Hupeh. All three species are good, though they show some variation in their content of active principle.

In 1887 the Japanese chemist, Nagai, isolated from Ma Huang the alkaloid *Ephedrine,* and later its isomer *Pseudoephedrine.* Chen and Schmidt by their physiological studies upon ephedrine introduced to scientific medicine this ancient remedy for asthma. It has since proven itself of great value as a therapeutic agent in the treatment of certain respiratory diseases. It is now recognized by the "New and Non-Official Remedies" of the American Medical Association, and is manufactured and sold by a number of the leading drug firms in America and Europe.

We have had a most enjoyable trip and have learned about many new things. How interesting it would be to investi-

gate a few more of these drug plants. Or to take a side trip to Formosa to see what we can find out about tea or camphor. A hunt for spices grown beyond the Seven Seas, with the aid of Mr. Wharton's spice list, would be delightful. But that, as Kipling says, is another story.

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Laboratory Equipment House Changes Name

The Cambridge Botanical Supply Co., long known by the abbreviated name "Cambosco," has for many years been supplying scientific materials for all branches of science. In order to have a name more in keeping with the complete scope of their service to schools they will be known in the future as "Cambosco Scientific Co." This is a change in name only. There is no change in ownership, policy or directing personnel of the organization

Effects of School Instruction on Student Achievement

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The school instructor who has ambitions to be efficient wants to know what effects his efforts are producing in the form of measured achievement. The only way to discover this is to have in mind definite objectives, devise valid and reliable tests to measure proficiency in the direction of the objectives, give such tests before and after instruction, and by subtraction of comparable scores, find the gains due to instruction. To be sure it is not easy to measure all phases of instruction. It is perhaps most difficult to measure the most valuable phases because they are often intangible. It is to be expected that all phases will yield to measurement as there are so many research workers now attempting to identify, define, and evaluate them.

The following tables giving data on Units III and XV present evidence of student proficiency in the field of high school physics before and after instruction and gains during the period of instruction. They sample units[1] of instruction designed to teach certain items of knowledge, appreciation, and technique. Similar tables have been prepared for nine additional units, but are omitted here for lack of space. The two chosen illustrate the two types obtained. Most of the distributions resemble closely those for Unit I. Those for Unit XV illustrate a desirability in the opinion of the writer. The attention of the reader is directed to the forms of the distributions in the preliminary and final tests and in the gains made; and to the degrees of proficiency as shown by medians and semi-interquartile ranges in the same. The facts shown may well stimulate us to investigate their relations to possibility. Do the facts disclose conditions which may be considered satisfactory or discrepancies which may be obviated?

While there are some differences manifested in the several units, the general similarities are more striking. For example, scores are rather closely concentrated toward the bottom in the preliminary tests. In the final tests, there is in almost

1 A. W. Hurd. Work-Test Book in Physics. Macmillan, 1930.

every unit a suggestion of a wider distribution resembling a normal distribution. For the gains, there is a wider range than in the preliminary test in all cases but one, and the distribution form resembles more closely the form for the preliminary test. If the ranges for preliminary, final, and gains are compared, in all cases but one, they are least for the preliminary test; in all cases but four (out of eleven) they are greatest for the final test; in the four, they are greatest for the gains.

The tables are self-explanatory.

TABLE I.—*Distribution of Scores on the Preliminary Test, Final Test, and Gains,* 1928-29, *Unit I*
(*Possible Score* 73)

PRELIMINARY TEST

0— 4	53
5— 9	62
10—14	63
15—19	45
20—24	34
25—29	11
30—34	4
35—39	1
40—44	1
45—49	0
50—54	0
55—59	0
60—64	0
65—69	0
	274

Median	R. S.* 11.75	% 16.1
Q	R. S. 5.90	% 8.1

* Raw Score.

FINAL TEST

0— 4	1
5— 9	1
10—14	9
15—19	16
20—24	33
25—29	49
30—34	49
35—39	35
40—44	32
45—49	27
50—54	10
55—59	8
60—64	4
65—69	0
	274

Median	R. S. 32.86	% 45.0
Q	R. S. 8.04	% 11.0

GAINS

0— 4	11
5— 9	11
10—14	41
15—19	68
20—24	51
25—29	43
30—34	22
35—39	11
40—44	9
45—49	4
50—54	2
55—59	1
60—64	0
65—69	0
	274

Median R. S. 20.59 % 28.2
Q R. S. 6.28 % 8.6

From a consideration of the score distribution, the medians and semi-interquartile ranges, it is apparent that instruction has definitely raised achievement scores but produced a higher range or variability among the pupils. Some pupils are seen to have a degree of proficiency on the preliminary test which they have acquired in other school courses, or outside of school. The mean score per preliminary test for all units is 17.8%; for final tests, 51.2%; and for gains, 34.8%. Whether this shows a satisfactory status may be a debatable question. If the tests sample rather fundamental concepts which they were designed to do, there is opportunity for higher achievement ratings and more universal mastery of the fundamental concepts. The distributions show many pupils making very little or practically no gain during the instructional period. Such conditions merit careful individual investigation.

Unit XV (Table II) shows the most satisfactory distribution of achievement ratings. From a generally low mean rating, by virtue of the most satisfactory gain shown, the highest mean final achievement is reached. This is very similar to Unit XVII (Table omitted). It would perhaps be legitimate to say that these two units have been planned better than any other units and the accomplishments have been more nearly in accordance with the plans. (Unit XV is on "Color and Some of Its Phenomena," and Unit XVII, on "X-Rays and Other Radiations.") The point of view in mind here is that the *common objectives should be attainable by the poorest normal pupil in the time given for the unit* and more superior

pupils may use the extra available time on special projects or other units of work.

Factors determining achievement must be kept in mind in investigations of individual achievement. For example, relatively few factors would determine scores in preliminary tests. They would include (1) past instruction in school courses covering the same or similar content, (2) past incidental instruc-

TABLE II.—*Distribution of Scores in Preliminary Test, Final Test, and Gains, 1929-30, Unit XV*
(*Possible Score* 79)

PRELIMINARY TEST

0— 4	34
5— 9	64
10—14	53
15—19	37
20—24	17
25—29	12
30—34	2
35—39	2
40—44	0
45—49	1
50—54	1
55—59	0
60—64	0
65—69	0
70—74	0
75—79	0
	223

Median R. S.* 11.37 % 14.4
Q R. S. 5.25 % 6.6

* Raw Score.

FINAL TEST

0— 4	0
5— 9	0
10—14	0
15—19	0
20—24	1
25—29	1
30—34	4
35—39	6
40—44	13
45—49	23
50—54	39
55—59	44
60—64	47
65—69	28
70—74	16
75—79	1
	223

Median R. S. 57.44 % 72.7
Q R. S. 6.43 % 8.1

GAINS

0— 4	0
5— 9	0
10—14	1
15—19	4
20—24	4
25—29	13
30—34	17
35—39	32
40—44	39
45—49	41
50—54	36
55—59	18
60—64	16
65—69	1
70—74	1
75—79	0
	223

Median R. S. 47.05 % 59.6
Q R. S. 7.32 % 9.3

tion in other school courses, and (3) past incidental learning outside of school. All of these are conditioned by (a) natural interest in the particular field, and (b) natural capacity to learn.

Relatively more factors would determine achievement in final tests. These would include all of the foregoing, and in addition (1) definite instruction in the fundamental concepts selected, (2) applied effort by the pupil (industry), and (3) the time spent on the work.

Relatively few factors would determine gains made. These would include the last three given in the preceding paragraph.

While teachers should be cognizant of all of these factors, they should be particularly concerned with the factors making for efficient instruction. There are three important elements which should receive careful consideration here, viz., (1) selection of content, (2) organization of instructional materials, and (3) methods used. In too many instances, teachers have little voice in selecting materials. This function is affected by such things as (1) an existing syllabus, (2) requirements of state examination boards, and (3) college entrance specifications. Teachers have, however, considerable latitude in organizing materials, but it is true that organization can never entirely overcome inadequacies in selection. Too voluminous selection makes impossible efficient organization, for time is a factor which cannot be neglected.

The use of efficient methods includes *teacher activities* and *pupil activities.* Learning studies have not made clear the nature of the best kinds of activity nor the proper degrees of teacher and pupil participation. Certainly the preponderant belief is that pupil activity is most important—and if self-activity can be stimulated in the right direction, distinct learning will most certainly follow. Teacher activities include (1) lecturing, (2) demonstrating, (3) assisting individual pupils, (4) directing pupils, (5) questioning, (6) supervising study, (7) testing, (8) answering questions, (9) aiding in discussions, and (10) assigning lessons.

Pupil activities include (1) reporting, (2) answering questions, (3) asking questions, (4) aiding in discussion, (5) study, (6) reciting, (7) assisting the teacher, (8) laboratory work, (9) taking tests, (10) writing exercises, (11) taking field trips, (12 debating, and (13) engaging in drill work.

Each activity has some place in instruction. It remains for teachers through serious contemplation and research to determine the particular contributions and best relative proportions of each to most efficient learning.

Study Dust Explosions

The United States Department of Agriculture has built an experimental "dust-explosion house," approximately 100 cubic feet in volume, with swinging iron vent doors and windows to permit the force of the explosion to escape without blowing up the building.

Engineers are now experimenting to determine the proper venting area necessary to protect buildings of various sizes in industries subject to dust explosions. Dust explosions are produced in the experimental house at will by blowing starch, grain dust, or other powdered combustible material from a number of hemispherical cups. The dust cloud is ignited by a heated electric coil.

There are at least 28,000 industrial plants in the United States subject to danger from dust explosions. These plants employ more than a million workers and manufacture products with an annual value of $10,000,000,000. Among the various products which yield explosive dusts are grain, starch, sugar, wood, paper, cork, fertilizer, dried milk, chocolate, rubber, and sulphur.

Copper

Roy Krueger, University High School, Iowa City

Long ago when the world was new
Was born a young fellow they called C. U.
Far beneath earth's grassy fold
He lived with his brothers, silver and gold,
'Til one day Sulfur, a beautiful girl,
Set young Copper's heart in a whirl.
So Copper and Sulfur, needless to say,
Were finally married one joyous day.
But fiery Sulfur with constant abuse
Prevented her hubby from being of much use.
With wife Sulfur he became old and gray
And would always have had to stay that way
Had not Judge Bessemer after much heat and force
Decided to give him his longed-for divorce.
But Sulfur enraged called in Oxy, her sister,
And pounded poor Copper into a large blister.
The Doctor then put injured Copper to bed
And with maple-sap soothed his bombarded head;
Meanwhile Cop's brothers feeling quite fine
Drank too much of that tingling current wine
And staggering blindly fell with a thud
Into the gutter slimy with mud.
So Copper now is lonesome and free
But far more important than he used to be.
For now that he's rid of matrimonial strife
He can lead a more pleasing and useful life.
He's a sturdy old fellow and can stand lots of heat
And is as red as an Indian from head to feet.
He can stretch out his body to a considerable length
And carry a current of very great strength
When the weather is rainy he turns so green
That his ruddy complexion can not be seen.
When in a race with zinc and lead
He never is able to come out ahead.
But when it comes to that Silver chap
Old Cop's got him backed clean off the map.
Sulfuric and Nitric bite him so
That never in them does he swimming go.
When with Miss Sulfate in his little green tug
He delights in killing every innocent bug.
Cop's very popular with the halogen bunch
And often goes to their house for lunch
But when hydrogen sulfide gets in sight
There's always sure to be a fight.
However, Copper, though he's strong and spry,
Generally emerges with a shining black eye.
He's used in making type and medals
Brass and Bronze and copper kettles.
Little children think he's a dandy
When they use him to buy candy.
For miles and miles he's stretched around
To carry energy from town to town.
In automobiles he's always seen,
And often on ships to keep them clean.
For many things he is employed
When with tin and zinc he is alloyed.
And as the earth makes its annual round
Some new use for him is found.
In fact, I don't know what we'd do
Without our dear, old friend C. U.

Students' Attitudes Regarding Unfounded Beliefs

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Numerous publications have dealt in one way or another with superstitions and other unfounded beliefs. A selected list of the most significant of these publications with brief annotations is presented at the close of this article. By use of these and other publications and data secured from the experiences and opinions of persons engaged in educational work, a list of unfounded beliefs was prepared. This list, including two hundred items, does not include all the unfounded beliefs that are regarded as important, and may possibly include some of small importance. However, the list was decided upon as a basis for collection of further information regarding the extent to which these ideas are known, and the influences they are thought to exert. The ultimate purpose is to secure redirection of subject teaching so as to present the facts and possibly change attitudes regarding these ideas. The part of the study reported here deals only with the prevalence and influence of the ideas included in this list. Part of this study has been published.*

The two hundred items were organized into a form to secure exact responses from high school and college students. Each person was asked to indicate whether he was aware of the particular belief, whether he believed it, and whether his actions are influenced by it. In order that those responding might respond clearly and accurately, the following explanations and illustrations were given in printed form to each student.

Explanation for division (a) Heard: If you have heard of the statement or the idea it conveys, check the word "Yes" √, after (a) Heard. If you have not heard of it, check the word "No" √.

Explanation for division (b) Believe: If you believe the statement is true, check the word "Yes" √ after (b) Believe. If you do not believe in it, check the word "No" √.

Explanation for division (c) Influenced: If you practice or follow the statement or if it affects or influences you in any way or manner, check the word "Yes" √ after (c) Influenced. If the state-

* Lundeen, Gerhard E., and Caldwell, Otis W., "A Study of Unfounded Beliefs Among High School Seniors." Jour. of Ed. Res., 22: 257-273, 1930.

ment has no effect upon you whatever, check the word "No" √. The two following examples will help to make this more clear:

A boy in school had his choice between two lockers, one numbered 12 and the other 13. He preferred the location of locker 13 but he decided to take locker 12 because he would rather not have anything to do with the number 13. This boy was influenced by the number 13.

A girl broke a mirror before coming to school one morning. She was somewhat anxious and afraid because she thought that breaking a mirror meant bad luck, or perhaps that some terrible tragedy would happen in her family. This girl was influenced by the breaking of a mirror.

High schools assisted by providing reports from their senior classes. The schools coöperating are located in large cities,—New York, Chicago, and Minneapolis, and in smaller cities and towns in Pennsylvania, Kentucky, Indiana and Kansas. College classes provided reports, these classes being in Columbia University, New York University, and the University of Illinois, the students being from homes widely distributed geographically, in all from 22 states. There were 918 usable returns from high school seniors (526 boys, 392 girls) and 264 usable returns from college students (108 men, 156 women).

As study of the return was made it soon became evident that certain differences between boys and girls and between those who live in different localities made it desirable to tabulate returns separately for boys and girls, and separately for those from cities and from towns. The first publication of some of the results from this study has been followed by many requests for the full list of two hundred items and for the tabulations for the different groups of students. Therefore, the entire list with numerical data for the different high school groups are here presented. Space for this publication does not permit similar tables for the college students, but certain findings for both college and high school students are presented in the summary.

The two hundred items of the study have been grouped in seven divisions, A to G, in the table below. This table presents, also, the responses from both high school seniors and college students, upon the three phases "Heard, Believed, and Influenced." It also presents a comparison between high school seniors in large and small cities.

RESPONSES TO DIFFERENT TYPES OF IDEAS

	A Weather Proverbs	B Signs of Luck, of Visitors, etc.	C Misconceptions about Health	D Misconceptions Derived from Astrology, Phrenology, etc.	E Misconceptions about Natural Phenomena (omitting weather proverbs)	F Witchcraft and Spiritualism	G Miscellaneous	H Total
I. *Number of items*	25	105	16	29	7	6	12	200
II. *Percent of ideas "heard" on the basis of total number of ideas*								
1a. High-school seniors	45.0	48.6	36.8	55.0	52.1	69.5	52.2	49.1
1b. College students	54.7	56.9	45.0	64.0	63.1	77.5	60.2	57.7
2a. High-school seniors of large cities	37.9	44.7	32.2	54.1	45.4	63.5	46.6	45.1
2b. High-school seniors of small towns	56.9	55.4	44.6	56.5	63.6	71.1	62.7	56.1
III. *Percent of ideas "believed" on the basis of those "heard"*								
1a. High-school seniors	44.9	10.7	20.1	31.6	44.6	13.0	17.6	20.4
1b. College students	28.7	3.2	12.5	18.1	30.1	8.7	8.4	10.8
2a. High-school seniors of large cities	47.9	10.6	20.6	32.1	44.6	10.9	16.6	20.4
2b. High-school seniors of small towns	41.5	10.8	20.0	30.9	44.7	16.5	18.7	20.3
IV. *Percent of ideas "influenced on the basis of those "heard"*								
1a. High-school seniors	33.4	18.3	22.6	30.5	35.2	14.8	16.6	22.6
1b. College students	23.7	12.7	18.9	23.1	28.0	13.7	9.4	16.5
2a. High-school seniors of large cities	29.6	14.6	19.2	28.7	30.2	10.6	12.8	19.1
2b. High-school seniors of small towns	37.7	23.3	26.8	33.4	41.2	21.6	21.3	27.3

Results from the study are summarized, though it is not possible to present here all of the statistical tables that have been prepared in the study.

A summary of results so arranged as to compare the responses of boys and girls, and the responses from small towns and large towns is presented below:

	A Boys				*B Girls*			
	Large City	*Small Town*	*D*	*D S.E. (diff)*	*Large City*	*Small Town*	*D*	*D S.E. (diff)*
Heard								
Mean	86.82	106.55	19.73	5.98	96.10	116.75	20.65	7.17
Belief								
Mean	16.58	21.06	4.48	2.73	21.76	24.19	2.43	1.20
Influence								
Mean	15.34	25.96	10.62	5.23	20.69	34.51	13.82	6.01
Number of Cases	373	153			205	187		

	C Small Towns Difference between Girls and Boys	S.E. (diff)	D Large Cities Difference between Girls and Boys	S.E. (diff)
Heard				
Mean	10.20	3.09	9.28	3.70
Belief				
Mean	3.13	1.45	5.18	3.55
Influence				
Mean	8.55	3.23	5.35	3.22

Senior high school students on an average have heard of approximately one-half of the total number of ideas in this study. On an average they believe in, and are influenced by approximately one-fifth of the ideas that they have "heard."

Of the high school seniors reporting in this study, those in rural communities have heard and are influenced by more unfounded beliefs than are those in large cities. It is possible that city pupils may be influenced by other unfounded beliefs than those included in this study.

High school senior girls are influenced by more of these unfounded beliefs than are high school senior boys. This is true both in rural communities and in city communities.

College students have heard of more of these unfounded beliefs than have high school seniors, but they believe in and are influenced by fewer of them than are high school students.

College women students have heard of and are influenced by more of these unfounded beliefs than are college men students.

Since the college students believe in and are influenced by fewer unfounded beliefs than are the high school students, it is possible though not proved that their education may have contributed to this difference. It is proposed to find if specific instruction as a part of regular subject teaching will produce further changes in these attitudes.

From the study thirty items (numbers 3, 5, 6, 7, 8, 9, 11, 13, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 30, 32, 35, 36, 37, 38, 39, 40, 43, 53, and 58) of unfounded or not adequately founded belief have been differentiated as being the more commonly heard, believed in, and influential. These have been selected as those to be used in further experimental teaching. They are being organized into existing units of subject matter for presentation to high school students. It is expected that checks will later show any changes in pupils' attitudes toward these items.

A Summary of the Responses of 918 High School Seniors to each of the 200 items	A Percent "Believed" on basis of "Heard" total number of boys and girls	B Percent "Influenced" on basis of "Heard" total number of boys and girls	C Percent "Heard" on basis of total number of boys and girls	D Percent "Believed" of boys on basis of total number of boys		E Percent "Influenced" of boys on basis of total number of boys		F Percent "Heard" of boys on basis of total number of boys		G Percent "Believed" of girls on basis of total number of girls		H Percent "Influenced" of girls on basis of total number of girls		I Percent "Heard" of girls on basis of total number of girls	
				Town	City	Town	City	Town	City	Town	City	Town	City	Town	City
1. When the plumage of birds is very heavy, that fact foretells a severe winter	80.06	48.55	33.9	29.4	29.2	23.5	17.4	44.4	32.7	20.9	27.3	12.8	12.7	31.0	30.7
2. Rainfall increases when the growing of trees and crops is increased	75.69	52.75	23.7	24.8	15.5	22.9	9.1	38.6	18.2	19.8	15 6	21.4	7.8	26.7	20.0
3. Frost is frozen dew	73.94	50.46	58.9	59.5	39.9	48.4	24.4	85.0	51.7	44.9	37.1	34.8	21.0	60.4	51.2
4. When bees store an extra supply of nectar that fact foretells a severe winter	72.86	43.66	36.9	30.1	29.5	23.5	16.6	51.6	35.1	19.3	26.8	11.2	14.1	35.8	30.2
5. Snow is frozen rain	71.21	52,48	79,1	60.1	57.1	47.7	39.7	87.6	78.8	53.5	54.6	47.1	35.1	79.7	72.7
6. If animals acquire an unusually heavy coat of fur, that fact foretells a severe winter	70.60	44.76	58.2	45.1	42.4	40.5	24.4	77.8	55.0	34.8	41.5	24.6	19.5	58.3	49.3
7. Winters now are less severe than they were 30 or 40 years ago	68.04	42.71	82.1	52.9	56.3	40.5	33.2	89.5	81.2	57.2	56.1	40.6	29.3	81.8	79.0
8. You can make an accurate estimate of an individual's intelligence by looking at his face...	62.13	56.40	80.0	43.8	52.5	39.9	48.8	73.2	83.6	46.5	51.7	41,2	45.9	75.4	82.4
9. When squirrels gather an unusual supply of nuts, that fact indicates a severe winter	62.06	37.77	61.4	41.8	41.3	33.3	22.0	72.5	60.3	28.9	38.0	21.9	19.0	63.1	53.7
10. If the sun draws water, rain will fall soon	57.72	42.69	45.9	29.4	22.0	26.8	13.7	71.9	31.9	36.9	22.9	32.1	14.1	64.7	34.6
11. When rheumatic people complain of more than ordinary pain in the joints, there will soon be rain	56.48	41.58	89.9	40.5	53.1	39.9	34.0	85.6	90.9	49.2	55.6	39.6	39.5	90.9	90.2
12. When the leaves of trees show their undersides, that fact is a sign of rain	53.51	40.13	32.6	22.2	9.9	18.3	5.6	49.0	19.8	31.6	4.9	26.2	10.7	49.7	27.8
13. A man's character may be judged by the features of his face	52.66	48.27	81.9	42.5	41.6	43.1	37.3	85.6	83.9	49.2	41.0	44.9	36.1	76.5	80.5
14. When the leaves of trees curl with the wind from the south,															

	sign of rain	53.51	40.13	32.6	22.2	9.9	18.3	5.6	49.0	19.8	31.6	4.9	26.2	10.7	49.7	27.8
*13.	A man's character may be judged by the features of his face	52.66	48.27	81.9	42.5	41.6	43.1	37.3	85.6	83.9	49.2	41.0	44.9	36.1	76.5	80.5
14.	When the leaves of trees curl with the wind from the south, rain will soon fall	52.46	36.36	15.6	7.2	8.6	5.9	6.2	24.8	12.1	10.2	6.3	7.0	3.4	19.3	11.7
*15.	If you stare at a person's back, you can make him turn around	52.09	52.09	65.2	35.9	25.5	39.2	22.5	74.5	56.0	47.1	36.1	52.9	33.7	78.6	62.9
16.	The changes of the moon cause definite changes in the weather	50.46	37.56	47.3	27.5	19.8	30.1	13.7	70.6	36.7	21.9	30.2	16.6	17.1	55.6	41.5
17.	When the corn husks are thick, the following winter will be severe	50.19	33.33	28.4	18.3	14.5	17.6	8.6	50.3	2.06	13.4	11.7	9.1	5.4	30.5	24.4
*18.	A circle around the moon is a sure sign of rain	48.46	39.24	60.2	35.3	24.4	36.6	16.6	87.6	46.1	35.8	27.3	32.6	18.5	77.5	49.8
*19.	Long, slender hands indicate an artistic nature	47.30	42.30	78.5	26.8	36.2	26.8	29.0	66.0	80.4	39.6	44.4	42.8	37.1	78.1	84.9
*20.	Children who are especially intelligent are likely to weak and retarded physically	46.63	34.75	74.3	34.6	37.5	27.5	27.1	71.9	78.8	27.8	35.6	24.1	23.9	66.8	74.6
*21.	In the days of old, human life was much longer than it is today	45.30	28.49	76.5	32.0	33.5	22.2	18.2	76.5	77.2	40.6	33.2	33.2	17.6	84.5	67.8
*22.	A person who does not look you in the eye is likely to be dishonest	44.83	44.71	87.5	44.4	33.0	43.8	33.5	87.6	89.3	44.4	42.0	48.1	37.6	86.1	85.4
*23.	Any physical or mental disease can be produced by thinking too much about it	43.81	39.97	65.1	20.3	35.9	22.9	29.2	70.6	70.2	25.1	24.4	26.2	17.6	58.8	64.9
*24.	Misfortunes never come singly	43.76	32.28	75.9	26.8	31.1	19.0	22.8	68.6	78.0	34.8	40.5	32.1	24.9	75.9	77.6
*25.	A high forehead indicates superior intelligence	40.20	38.03	85.1	29.4	38.6	29.4	36.2	80.4	90.6	25.1	38.0	26.7	32.7	72.2	90.2
*26.	A square jaw is a sign of strong will power	40.06	37.98	74.0	21.6	37.3	27.5	32.7	70.6	82.6	18.2	33.7	20.3	27.3	57.2	76.1
*27.	During long periods of drought, individuals or groups of individuals by their prayers can cause it to rain	38.97	29.54	61.2	43.8	8.3	34.0	5.1	70.6	58.2	50.3	13.2	40.6	9.3	70.6	51.2
28.	Oysters should be eaten only in months in whose names the letter R is found; in other months oysters are unwholesome	37.98	37.21	28.1	5.9	13.7	7.8	11.5	17.0	33.2	8.0	11.2	9.6	11.2	26.7	28.2
29.	Cobwebs on the grass are a sign of wet weather	37.91	25.27	19.8	9.2	5.9	8.5	3.2	24.8	13.7	11.8	5.4	7.0	3.9	31.6	16.6
*30.	Brains and beauty rarely go together	37.81	29.93	88.5	23.5	35.9	22.2	25.7	83.0	89.0	33.2	36.6	32.1	25.9	87.2	92.7
31.	Tree frogs "singing" is a sign of wet weather	35.99	27.68	31.5	15.7	5.1	14.4	3.8	47.1	16.9	20.3	11.2	17.6	5.4	54.0	25.9
*32.	If March comes in like a lamb, it goes out like a lion	33.99	31.55	71.5	31.4	14.2	32.0	11.8	88.2	57.6	36.9	25.9	42.2	17.1	92.0	65.4
33.	It often rains on July 4th because of so much fireworks and discharge of guns	33.67	27.55	32.0	19.6	8.8	19.6	5.6	45.8	27.1	8.6	9.8	9.1	6.3	36.9	26.3
34.	Clouds travel against the wind	33.21	29.15	29.5	15.0	4.6	15.7	3.8	49.7	19.3	17.6	8.3	15.0	6.3	39.6	23.9

A Summary of the Responses of 918 High School Seniors to each of the 200 items	A Percent "Believed" on basis of "Heard" total number of boys and girls	B Percent "Influenced" on basis of "Heard" total number of boys and girls	C Percent "Heard" on basis of total number of boys and girls	D Percent "Believed" of boys on basis of total number of boys		E Percent "Influenced" of boys on basis of total number of boys		F Percent "Heard" of boys on basis of total number of boys		G Percent "Believed" of girls on basis of total number of girls		H Percent "Influenced" of girls on basis of total number of girls		I Percent "Heard" of girls on basis of total number of girls	
				Town	City	Town	City	Town	City	Town	City	Town	City	Town	City
35. Fat people are always good-natured	32.88	32.38	87.5	32.7	24.9	32.7	24.7	86.9	85.5	33.2	28.8	36.9	23.9	90.4	88.8
36. Dew falls from the sky	32.76	23.34	50.9	19.0	11.8	17.6	8.0	62.7	45.3	20.3	20.5	16.6	10.2	54.5	48.8
37. Some snakes charm birds and other animals, even human beings	32.71	26.32	58.0	26.8	18.5	25.5	12.1	76.5	56.3	20.9	12.2	19.8	9.3	63.6	42.0
38. The general form and condition of the hand, the shape and markings on the fingers indicate fitness for social, intellectual or practical work	32.55	31.38	55.9	12.4	20.1	13.7	17.4	46.4	61.7	12.3	24.4	16.0	22.0	47.6	60.0
39. Red hair is a sign that the possessor has a violent temper	32.51	34.49	88.1	25.5	21.7	32.0	21.4	89.5	80.4	33.7	39.0	41.2	35.6	96.3	93.7
40. Brunettes are more trustworthy than are blondes	31.41	32.40	66.2	19.6	17.7	21.6	19.0	60.1	66.8	25.7	22.9	25.7	22.0	64.7	71.2
41. Thunder will cause milk to sour	30.70	31.58	37.3	17.6	4.0	20.3	3.8	61.4	23.6	27.3	5.9	28.3	4.9	61.5	22.0
42. A cat should never be left alone with a sleeping child, as the cat may take the child's breath away and thus kill it	30.07	27.39	48.9	9.8	8.3	10.5	6.2	52.3	37.0	26.2	19.5	29.4	14.1	72.2	46.8
43. A snake's tail will not die until sun-down	29.12	27.54	62.1	23.5	14.7	24.2	11.3	83.7	59.8	26.2	12.7	32.1	8.8	77.5	36.1
44. Brunettes are more alert and violent-tempered than are blondes	28.11	26.73	47.3	17.6	10.2	19.6	8.0	52.3	39.1	16.0	13.2	18.2	10.7	59.4	47.3
45. If the sun shines while it is raining it will rain again tomorrow	27.73	30.67	40.9	19.6	3.5	22.2	2.4	71.9	16.1	27.8	4.4	34.8	3.4	84.5	22.9
46. If the points of the new moon are turned up, it is a sign that the following month will be dry; if they turn down it indicates a wet month following	27.53	21.91	19.4	7.8	2.7	7.8	2.1	41.8	9.4	11.8	2.4	8.6	1.5	31.0	10.2
47. The divining-rod (generally a forked twig of the apple, willow															

47.	The divining-rod (generally a forked twig of the apple, willow or hazel) will, in the hands of a certain kind of person ("dowser"), indicate underground streams of water	27.19	24.69	34.9	22.9	6.4	21.6	4.6	65.4	32.2	10.7	3.9	13.4	2.0	34.2	17.6
48.	A disease one may have is sometimes a direct punishment for some particular sin	24.92	22.52	68.2	22.9	14.2	22.2	12.1	75.2	67.0	23.5	11.7	26.7	5.9	73.3	60.5
49.	A person with a prominent Roman nose possesses a good fighting instinct	24.76	24.05	45.8	13.7	10.7	13.7	11.5	57.5	45.2	10.2	11.7	10.2	8.8	42.8	44.4
50.	If the eyebrows meet, the possessor is ill-tempered	24.10	24.87	42.5	11.8	8.0	12.4	8.0	45.8	40.5	10.2	13.2	11.2	13.2	38.0	47.8
51.	If you tickle a baby you will cause it to stutter	23.48	27.70	41.3	14.4	2.9	17.0	3.5	56.2	20.4	18.7	10.2	25.7	8.8	75.4	37.1
52.	If rats leave a ship when it is leaving land, it is a sign that the ship will sink on that trip	21.65	15.81	44.8	5.9	14.2	7.8	9.7	45.8	56.3	5.3	8.3	3.7	4.9	27.3	39.0
53.	If you find a four-leafed clover it will bring you good luck.....	21.06	30.98	98.8	20.3	16.9	33.3	19.8	97.4	98.9	23.5	25.9	48.1	32.2	99.5	99.0
54.	Lightning never strikes twic in the same place	20.98	21.99	74.3	17.6	15.9	19.6	13.1	88.2	80.7	13.9	16.6	22.5	14.1	70.1	56.1
55.	When a cat or dog eats grass that foretells rain	20.59	18.82	18.5	6.5	2.4	7.2	1.6	30.1	11.5	4.3	3.9	5.9	2.0	25.1	16.6
56.	Hairy arms mean strength to the possessor	20.56	21.44	62.0	16.3	13.1	20.3	12.6	62.7	74.3	8.6	13.2	8.6	13.7	41.7	57.6
57.	Seeds when planted in the increase of the moon quickly than when planted in the decrease of the moon	20.56	19.76	27.0	15.0	1.3	16.3	1.3	57.5	11.5	10.7	1.5	9.1	1.0	47.1	14.1
58.	If the ground-hog sees his shadow on ground-hog day (Feb. 2nd), there will be six weeks of bad weather	20.23	22.96	75.9	12.4	7.8	19.6	7.5	98.0	60.6	31.6	16.6	40.6	12.7	98.9	66.3
59.	When boasting or bragging of your good luck, knock on wood to keep your luck from changing	19.98	39.48	91.6	15.7	16.9	37.3	28.1	86.9	89.5	19.8	21.5	49.7	37.6	95.7	95.1
60.	Cold hands mean a warm heart	19.11	24.22	66.1	9.2	7.8	12.4	9.1	59.5	48.0	18.2	19.0	28.9	19.5	89.3	82.9
61.	Trees or timber should be cut in the increase of the moon....	19.05	15.87	13.7	8.5	.8	9.2	.5	28.8	5.9	3.7	.5	2.1	0	23.5	7.8
62.	The bite of spiders is poisonous	17.28	23.56	41.6	8.5	2.9	17.0	4.6	62.7	31.4	16.6	5.4	19.3	5.4	58.8	28.8
63.	If you dream of the dead, you will hear from the living	16.49	20.35	31.0	3.9	2.7	2.6	3.2	24.8	20.1	9.1	6.8	16.0	5.9	52.4	36.1
64.	Seven is a lucky number	16.39	19.67	73.1	19.0	13.7	22.9	16.1	79.1	76.9	7.5	7.8	10.7	8.3	65.8	68.3
65.	If a baby is good-looking it will grow up ugly; if ugly it will become good-looking when grown	16.37	19.10	67.9	15.0	7.2	13.7	7.0	65.4	52.5	17.6	9.3	27.3	10.2	89.8	77.6

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				Town	City	Town	City	Town	City	Town	City	Town	City	Town	City
66. The almanac can predict the weather conditions each day for a whole year in advance	16.10	21.58	67.6	9.8	11.3	21.6	11.3	92.8	52.8	10.7	11.2	23.5	7.3	92.5	53.2
67. If you sing before breakfast you will cry before night	15.85	23.14	68.7	7.8	5.9	11.1	9.1	56.9	59.2	12.3	21.0	24.1	24.4	81.3	83.4
68. If you drop a knife, fork, or spoon, you may expect company soon	15.66	22.84	66.8	5.9	7.2	7.8	8.8	55.6	54.4	15.0	15.6	29.9	19.0	87.2	79.0
69. Dream go by contraries, this is, if you dream of one thing, the opposite will come true	15.30	16.67	47.7	7.2	4.6	7.8	4.3	33.3	43.4	9.6	10.2	11.8	11.2	49.2	64.9
70. If you plant potatoes during the light of the moon, you will have a good crop	15.14	17.79	45.3	18.3	.5	19.6	.5	83.7	19.3	16.0	1.5	20.9	1.5	86.1	26.8
71. To hear a "wood-tick" or "death-watch" is a sign of death	15.00	15.00	10.9	2.0	.5	1.3	.5	14.4	7.2	2.7	2.4	3.7	2.0	13.4	12.7
72. If you have one disappointment you will have two others to follow	14.98	18.12	31.3	6.5	2.9	5.9	2.9	35.3	22.5	7.5	3.9	10.2	6.3	40.6	36.6
73. People with greenish-gray eyes are less trustworthy than people with blue or brown eyes	14.93	17.33	40.8	7.8	6.4	9.2	5.9	34.6	42.4	2.1	7.8	5.3	9.3	35.8	45.4
74. If you drop a dish-cloth it is a sign you will soon have company	14.67	21.26	36.4	1.3	3.2	5.2	2.9	42.5	20.4	14.4	3.9	24.6	2.9	73.8	26.8
75. If a cat "washes its face" it is a sign that company is coming soon	14.54	17.73	30.7	3.9	2.9	2.6	2.9	34.0	19.6	5.3	6.8	10.2	7.8	42.2	38.0
76. If you find a horseshoe you will have good luck	14.41	21.73	96.7	13.7	12.1	24.2	16.4	95.4	97.9	13.4	18.0	28.3	20.5	95.7	96.6
77. It is bad luck for a black cat to cross the street or road in front of you	14.22	32.11	98.0	14.4	10.2	39.9	22.0	88.7	97.3	18.2	16.6	46.5	28.8	98.9	98.0
78. If your right ear itches or burns, somone is speaking well of you	14.11	19.22	72.5	2.6	8.0	3.3	8.8	52.3	69.8	10.2	20.0	27.8	18.5	79.7	86.3
79. Good people die young	13.94	15.37	75.9	3.3	10.5	9.2	10.2	64.7	76.1	13.9	13.2	17.6	10.7	76.5	82.9
80. A sore throat may be cured by															

78. If your right ear itches or burns, somone is speaking well of you	14.11	19.22	72.5	2.6	8.0	3.3	8.8	52.3	69.8	10.2	20.0	27.8	18.5	79.7	86.3
79. Good people die young	13.94	15.37	75.9	3.3	10.5	9.2	10.2	64.7	76.1	13.9	13.2	17.6	10.7	76.5	82.9
80. A sore throat may be cured by binding about the neck, on going to bed, one of the stockings which the patient has been wearing	13.91	16.52	25.1	2.6	2.4	4.6	2.4	26.8	18.0	5.3	4.4	6.4	4.9	41.2	22.0
81. If you handle a toad, you will have warts	13.57	20.60	91.5	8.5	11.0	22.2	13.7	96.7	89.0	15.5	15.1	31.0	14.6	96.8	87.3
82. The body of a human being should be buried so that the head lies to the east	13.45	13.87	25.9	5.2	1.9	5.9	1.9	37.9	17.2	5.3	3.4	5.3	3.4	37.4	22.4
83. Three is a charm or a lucky number	13.44	21.64	47.8	13.1	1.9	20.3	3.2	69.3	36.7	13.4	3.4	23.5	3.9	64.2	37.4
84. The bride should wear something old, something new, something borrowed, something blue, else bad luck will follow	13.42	20.26	41.4	1.3	1.6	3.9	2.7	30.1	27.6	8.0	13.7	16.0	15.1	66.8	51.7
85. To dream of death means a wedding will soon occur	13.27	16.84	42.7	5.2	2.7	6.5	1.6	35.9	26.5	9.6	7.8	17.6	8.3	71.7	50.7
86. If you drop a fork, it is a sign that a man is coming to call	13.19	19.15	43.8	3.3	3.5	4.6	4.3	35.3	34.6	9.6	8.3	16.0	11.7	62.6	49.8
87. If you drop a knife a woman is coming to call	13.10	18.64	43.2	3.9	3.5	3.9	4.3	34.0	34.6	9.1	7.8	17.1	9.8	62.0	48.8
88. It is unlucky to pass through a funeral procession, either between carriages or through the file of mourners on foot	13.04	21.74	29.2	6.5	2.9	10.5	4.8	43.1	36.5	9.1	4.9	15.0	8.8	50.8	34.6
89. If your luck is poor when playing cards, get up and walk around the table three times for good luck	12.99	21.47	38.6	8.5	5.5	13.1	7.5	45.8	42.4	4.3	2.4	9.6	4.9	35.3	29.3
90. If a snake crosses your path it means that you have an enemy near you	12.83	15.04	24.6	5.2	1.9	6.5	1.6	37.9	19.9	2.7	4.4	5.9	3.4	29.4	20.5
91. If you cut your hair during the new moon, it will grow better better than if cut during the full moon	12.82	18.80	12.7	2.0	0	2.6	0	15.0	5.4	4.3	2.0	6.4	2.9	24.6	13.7
92. If a rooster crows before the front door, you will have company soon	12.66	24.47	25.8	4.6	.3	7.8	0	40.5	8.8	10.7	1.0	22.5	2.0	58.3	16.1
93. If you have company on Monday, you will have company every day in the week	12.61	20.17	25.9	3.3	.5	3.9	.8	41.8	12.3	9.1	2.9	16.6	3.9	53.5	13.7
94. If your right hand itches, you you will soon shake hands with a friend	12.53	13.49	45.2	1.3	3.5	2.6	3.2	39.9	36.5	10.7	8.3	15.5	5.4	58.3	53.2
95. When playing cards, it is unlucky to play against the grain of the table	12.50	19.79	10.5	4.6	1.1	6.5	1.3	19.0	3.8	.5	0	1.1	1.0	10.2	7.3

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				Town	City	Town	City	Town	City	Town	City	Town	City	Town	City
96. The bite of all kinds of snakes is poisonous	12.47	21.03	44.6	3.3	2.9	13.1	6.2	58.8	36.2	12.3	5.9	16.0	6.3	58.3	36.6
97. You can cure a sty by rubbing it with a wedding ring	12.37	18.82	20.3	2.6	.5	3.9	1.3	20.9	12.1	5.3	3.4	8.6	3.9	33.2	22.9
98. If you make a wish upon seeing the first star in the evening, the wish will come true	12.30	29.34	69.1	7.2	4.6	19.0	5.4	67.3	50.9	11.2	13.7	43.8	26.8	89.3	84.9
99. If you dream of snakes, you have an enemy	12.28	12.72	24.8	3.3	.8	3.9	.5	28.1	13.9	5.3	4.9	8.6	2.4	44.4	24.4
100. If you sing before breakfast you will cry before supper	12.10	17.58	47.7	4.6	2.9	5.9	4.3	28.6	37.5	6.4	11.2	13.9	12.7	59.9	62.0
101. If two people make wishes while breaking a wishbone, the one who gets the longer piece will see the fulfillment of his wish	12.10	33.79	95.4	9.8	11.0	30.1	24.1	97.4	93.3	10.7	14.6	50.3	32.2	96.3	97.1
102. "Every part strengthens a part," that is, any organ of an animal develops the same part in the person who eats it	12.00	11.42	19.1	5.9	2.1	6.5	1.1	24.8	21.2	1.6	.5	2.1	1.0	18.2	11.7
103. If your nose itches, you will have company soon	11.98	23.27	47.3	7.8	1.3	13.1	2.3	73.9	20.6	15.0	3.4	33.7	6.3	94.7	32.7
104. If you sing before you eat, you you will cry before you sleep	11.88	17.10	45.9	1.3	3.2	3.3	4.8	37.3	35.9	7.0	11.2	13.4	11.7	57.2	60.0
105. If you give to a friend as a present, a knife or any sharp instrument, it will cut your friendship	11.59	18.29	35.7	4.6	1.1	6.5	2.7	29.4	30.0	8.6	5.5	14.4	6.3	51.3	36.6
106. If a stray cat comes to your house, it will bring good luck	11.26	14.51	34.5	3.9	2.7	6.5	2.9	44.4	28.4	6.4	3.9	9.6	3.4	45.5	28.3
107. People born under the influence of certain stars, show this influence on their character	11.26	13.36	57.1	3.9	5.6	6.5	6.2	41.8	68.2	7.0	9.3	9.6	9.3	55.1	61.0
108. If a strange cat comes to your															

108.	If a strange cat comes to your house, it will bring you good luck	11.24	14.34	28.1	2.6	2.1	5.2	2.1	34.6	23.3	4.8	3.9	7.5	3.4	37.4	23.4
109.	When you see the first star at night, look steadily at it while saying the following rhyme: "Starlight, star bright, First star I've seen tonight, I wish I may, I wish I might Have the wish I wish tonight." Then your wish will come true.	11.04	29.87	67.1	6.5	1.6	19.0	4.3	71.2	42.6	12.3	14.1	46.0	25.9	93.6	84.4
110.	If a dog howls, it is a sign of death soon to occur in the family	10.90	15.05	63.0	4.6	6.4	8.5	7.0	68.6	62.2	8.6	7.8	15.0	9.8	66.8	56.6
111.	It will bring bad luck to turn back after having started on a journey	10.89	15.32	66.0	6.5	5.1	9.8	8.3	66.0	56.6	7.0	11.7	11.2	17.1	78.1	72.2
112.	If you hang a horseshoe over your door, it will bring good luck	10.81	19.8	97.7	9.8	10.2	20.9	16.6	94.8	99.2	9.6	12.7	25.1	15.1	97.9	97.1
113.	If two friends walk on opposite sides of a post they will quarrel	10.59	24.31	55.6	5.2	2.1	16.3	2.4	59.5	30.6	11.2	8.3	31.6	15.1	89.8	66.8
114.	It is bad luck to walk under a ladder	10.48	25.74	95.6	9.2	11.8	26.1	21.7	92.2	97.6	8.6	13.7	31.6	22.4	94.1	96.1
115.	If you drop a fork, it means a woman is coming to call	10.47	17.57	32.2	2.0	1.6	3.3	2.7	26.1	21.2	6.4	4.9	12.8	6.3	55.1	36.1
116.	It means a quarrel when walking together with another to let any objection come between you; if you say, "Bread and butter," you can avert the quarrel	10.43	30.21	51.2	3.9	.8	13.7	2.4	52.3	26.0	12.8	7.8	44.9	13.7	87.7	62.9
117.	If a clock suddenly strikes after it has not been doing so for a long time, it is a sign of death	10.27	13.69	28.6	4.6	.5	8.5	.8	41.8	20.4	4.8	4.4	6.4	3.9	38.5	24.9
118.	If a stray black cat follows you, you will have good luck	10.00	14.09	24.0	2.6	1.9	4.6	1.9	34.6	18.2	3.7	2.0	5.9	2.9	27.8	22.9
119.	If you kill any animal for meat during the decrease of the moon, it will shrink as it is cooked	10.00	11.25	8.7	2.0	.3	2.6	.3	16.3	3.5	2.1	0	2.1	0	15.5	6.3
120.	It is bad luck to light three cigarettes or cigars with one match	9.91	18.10	50.5	10.5	4.8	20.3	8.8	65.4	65.1	3.2	2.9	5.3	4.9	25.7	35.6
121.	Certain lines and markings in a person's hand foretell his future	9.89	13.46	82.6	4.6	7.0	7.2	8.0	72.5	82.0	8.6	12.7	17.1	14.1	86.1	87.8
122.	It is a sign of a quarrel to spill salt	9.85	13.42	48.7	2.6	3.5	3.9	5.1	36.6	54.4	4.3	7.3	8.0	9.8	36.9	58.0
123.	To open an umbrella in the house brings bad luck	9.77	19.42	90.3	7.2	5.9	15.0	11.0	87.6	84.7	10.7	13.7	27.8	22.0	98.4	95.1

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				Town	City	Town	City	Town	City	Town	City	Town	City	Town	City
124. If you tell a dream before breakfast it will come true	9.74	24.47	30.5	5.2	1.1	11.8	1.1	59.5	11.2	7.5	5.4	30.5	6.8	85.0	29.8
125. Taking a ring off another's finger will break your friendship with that person	9.72	22.27	46.0	5.2	1.6	7.2	2.1	43.1	30.6	5.9	7.8	28.9	10.2	75.4	49.3
126. If your left ear burns, someone is saying something bad about you	9.61	14.60	58.9	3.3	2.4	3.3	3.5	39.2	53.1	8.0	11.2	21.4	10.2	75.4	69.3
127. If you change your garment which has been put on wrong side out, it will bring bad luck	9.56	16.18	44.4	2.6	1.9	3.3	1.9	29.4	27.9	6.4	7.8	16.6	11.2	72.7	60.0
128. If, on leaving the house, it is necessary to go back for something forgotten, bad luck will result unless a person sits in the house before starting out again	9.51	13.54	37.8	1.3	2.4	2.0	3.8	32.7	31.9	5.3	5.9	8.0	7.3	48.1	42.9
129. Rub a wart with a stolen dishcloth and then hide or bury the latter; as it decays the wart will disappear	9.43	12.74	23.1	2.6	.8	3.3	.5	33.3	10.7	3.7	2.9	7.0	3.4	44.4	18.5
130. If two people accidentally say the same thing at the same time and then link fingers together and make a wish, it will come true	9.41	28.92	79.8	8.5	5.1	16.3	11.8	60.8	71.8	10.2	8.8	48.7	25.4	97.3	92.7
131. If you make a wish while looking at a load of hay, it will come true, provided you do not look at the hay again	9.29	26.10	24.6	1.3	.3	2.6	1.1	20.9	12.6	3.7	5.4	16.6	9.8	44.4	31.2
132. If you count the carriages in a funeral procession, you will have bad luck	9.22	17.87	37.8	3.9	1.9	7.2	3.2	37.3	32.4	6.4	3.4	12.8	7.3	48.7	38.0
133. To find a pin with the point towards you is good luck	9.07	16.08	52.8	4.6	1.3	8.5	2.1	57.5	39.4	9.6	6.8	24.1	5.9	79.1	49.8
134. A hooting owl is a sign of bad luck	9.01	13.51	48.4	5.2	2.7	8.5	3.5	47.1	48.2	5.9	5.5	13.4	4.4	47.6	50.2
135. A twig across the path is a sign															

133.	To find a pin with the point towards you is good luck	9.07	16.08	52.8	4.6	1.3	8.5	2.1	57.5	39.4	9.6	6.8	24.1	5.9	79.1	49.8
134.	A hooting owl is a sign of bad luck	9.01	13.51	48.4	5.2	2.7	8.5	3.5	47.1	48.2	5.9	5.5	13.4	4.4	47.6	50.2
135.	A vein across the nose is a sign of short life	8.99	13.48	9.7	.7	1.1	2.0	1.3	15.0	8.0	1.1	.5	1.6	.5	9.6	8.8
136.	If you wear amber beads about your neck, you will not have a goiter	8.98	11.38	18.2	2.0	.5	2.0	.3	22.2	8.6	2.7	2.4	5.3	2.4	33.7	18.5
137.	If you see a star falling, it is a sign that someone is dying	8.93	12.14	61.5	7.2	3.5	11.8	4.3	58.8	60.1	5.3	7.8	11.8	5.9	63.1	62.4
138.	If you are born under a lucky star you will be successful and prosperous	8.90	10.33	68.5	5.9	4.8	7.8	4.8	58.2	73.2	4.3	10.2	10.7	7.3	64.7	71.2
139.	It is unlucky to kill a cricket..	8.89	14.92	34.3	3.9	1.9	7.2	2.1	43.1	26.8	5.9	2.0	12.3	2.4	46.0	30.7
140.	It is a sign of bad luck to take off your wedding ring	8.89	19.90	64.9	4.6	3.5	5.9	2.1	56.9	60.3	6.4	10.2	10.7	9.3	73.3	71.7
141.	Never begin a piece of work on Friday, for you will have bad luck if you do	8.85	12.92	45.5	3.9	2.1	8.5	1.6	58.8	31.9	7.5	4.4	12.8	5.4	73.3	35.1
142.	To dream of a wedding is a sign of a funeral	8.83	9.89	30.8	1.3	1.1	.7	.5	28.8	16.4	4.8	4.9	8.0	4.9	58.8	33.2
143.	You will have an unhappy married life if you lose your wedding ring	8.81	10.58	49.5	5.9	2.7	9.2	3.5	50.3	45.3	3.7	6.8	4.8	5.9	52.4	53.7
144.	If a task is begun on Friday, it will never be successfully completed	8.80	13.46	44.6	3.3	1.1	5.2	1.1	58.2	29.8	9.1	4.9	17.6	4.9	75.9	32.7
145.	Do not bring peacock feathers into the house, because they bring bad luck	8.70	10.87	10.00	2.0	.3	2.0	.3	11.1	7.0	.5	1.5	1.6	1.5	15.5	9.8
146.	On a child's birthday he should receive a blow with the hand or switch for every year of his life. This brings him good luck.....	8.68	24.75	76.6	5.9	8.3	18.3	18.2	67.3	77.2	4.3	6.3	19.8	20.0	73.3	85.4
147.	Old shoes, slippers, or rice must must be thrown after a bride for good luck	8.61	17.71	88.6	3.9	6.7	11.1	11.8	77.1	90.1	8.0	11.7	26.2	16.6	93.6	89.8
148.	A witch is someone who is engaged in doing harm, bringing spells, or bewitching people, animals and objects	8.21	6.89	74.3	7.8	5.1	9.8	2.9	73.9	77.5	7.5	5.4	7.0	3.9	69.0	73.7
149.	If you kill a cat, you will have have bad luck	7.98	13.22	43.7	5.2	2.4	13.7	2.4	81.0	29.5	7.5	.5	10.7	1.5	63.1	23.9
150.	If a bird flies in at the window there will be a death in the family	7.69	15.02	29.8	1.3	.8	7.2	1.3	41.8	15.8	5.3	2.9	10.2	2.9	47.1	30.2
151.	Some houses are haunted	7.68	14.60	85.1	6.5	4.3	13.7	7.8	85.6	85.3	11.8	5.9	25.7	7.8	93.0	77.1
152.	If you spill salt, you will quarrel with a friend, unless you throw some of the salt over your left shoulder	7.59	13.45	50.2	2.6	2.9	4.6	4.8	37.9	58.2	4.8	5.4	8.6	10.2	35.8	58.0

A Summary of the Responses of 918 High School Seniors to each of the 200 items	A Percent "Believed" on basis of "Heard" total number of boys and girls	B Percent "Influenced" on basis of "Heard" total number of boys and girls	C Percent "Heard" on basis of total number of boys and girls	D Percent "Believed" of boys on basis of total number of boys		E Percent "Influenced" of boys on basis of total number of boys		F Percent "Heard" of boys on basis of total number of boys		G Percent "Believed" of girls on basis of total number of girls		H Percent "Influenced" of girls on basis of total number of girls		I Percent "Heard" of girls on basis of total number of girls	
				Town	City	Town	City	Town	City	Town	City	Town	City	Town	City
153. A group of bubbles on a cup of coffee or tea signifies that money will soon come to you	7.57	18.33	27.3	2.6	1.1	6.5	1.3	29.4	17.2	2.1	3.4	10.7	5.4	46.0	27.3
154. When a child smiles in his sleep angels are talking to it	7.55	6.18	47.6	3.3	2.7	2.6	2.1	41.2	45.6	5.3	3.9	5.3	2.4	47.6	56.1
155. The one who catches the bride's bouquet when thrown at the wedding, will be the next to be married	7.48	14.62	65.6	2.6	2.4	7.2	2.7	51.0	55.5	4.3	11.7	17.1	17.1	75.9	85.4
156. Spitting on fish bait will cause the fish to bite	7.42	17.19	27.9	6.5	.8	15.0	1.3	64.1	19.3	2.1	1.0	5.9	2.4	32.1	12.7
157. Never take a broom with you when you move into another house, for it is a sign of bad luck	7.41	10.19	23.5	2.0	1.6	2.6	2.1	26.8	17.7	2.1	1.5	3.2	2.0	33.2	22.9
158. Horse hairs will turn into snakes when placed in water	7.22	10.70	40.7	7.8	0	13.7	.8	75.2	27.3	7.0	1.0	6.4	2.0	56.1	25.4
159. If you wish while you see a falling star, you will get your wish	7.09	19.03	53.8	3.9	2.9	11.8	4.3	54.2	48.8	3.7	5.4	21.4	9.8	63.6	53.7
160. A wish made on a load of hay will come true	7.07	20.20	21.6	.7	.5	2.6	.5	16.3	12.6	2.1	3.4	11.8	5.9	35.3	29.3
161. If you break a mirror you will have bad luck	7.03	16.18	92.9	7.8	2.9	20.3	8.8	95.4	91.7	9.1	9.8	21.4	16.6	93.0	93.2
162. If a person comes into your house through the front door and leaves through the back you will soon have more company	6.95	16.04	20.4	1.3	.3	2.6	0	23.5	8.6	3.2	2.0	11.2	2.4	48.7	13.7
163. It is good luck to carry a rabbit's foot in your pocket	6.88	9.70	96.6	5.9	6.4	9.8	9.1	94.8	97.9	7.0	7.3	12.3	6.8	96.7	96.6
164. Friday is an unlucky day	6.88	12.24	79.2	4.6	4.3	12.4	5.9	91.5	76.4	8.0	5.9	15.5	9.3	91.4	63.9
165. Cut your hair the first Friday in the new moon if you wish it to grow well	6.85	10.96	8.0	1.3	0	1.3	0	8.5	3.2	1.6	0	2.1	1.0	12.3	12.2
166. If you see the new moon through trees or brush you will have															

166. If you see the new moon through trees or brush you will have trouble that month	6.57	8.03	14.9	2.0	0	2.6	.5	18.3	12.9	3.2	0	2.7	0	20.9	10.7
167. To carry a hoe, rake or spade through the house will bring bad luck	6.48	10.12	26.9	3.9	.8	5.9	1.3	41.2	20.9	3.2	.5	4.8	1.0	36.9	18.0
168. If the palm of your left hand itches, it is a sign that you will receive money	6.45	10.28	62.5	2.6	2.9	3.9	3.2	43.1	64.3	5.3	5.9	12.8	8.3	60.4	75.6
169. Misfortune will come to you if you start a journey on Friday	6.44	9.33	49.0	3.9	1.6	8.5	1.3	66.0	38.6	3.7	4.9	6.4	5.9	69.0	37.1
170. An ugly, ill-tempered old woman is often thought to be a witch	6.12	7.17	51.6	3.3	2.1	3.9	3.2	52.3	46.9	5.9	2.4	6.4	2.0	57.2	54.6
171. A child born on a saint's day should be given the saint's name	6.10	6.10	23.2	.7	1.6	.7	1.6	24.8	21.7	1.1	2.0	2.1	1.0	20.3	27.3
172. If you sit on a table you will not be married during that year	6.08	8.78	16.1	2.0	.3	2.6	.5	14.4	7.8	1.6	1.0	2.7	1.0	34.2	16.1
173. If you drop the scissors and the points stick into the floor, it is a sign of good news soon to come	6.03	9.52	34.3	1.3	1.6	2.0	1.3	35.9	28.7	3.2	2.4	7.5	3.9	44.4	34.1
174. If you kill any animal for meat during the increase of the moon, it will increase in volume when cooked	5.95	8.33	9.2	.7	.3	2.0	.3	20.9	4.0	1.6	0	1.6	0	13.9	5.5
175. If you see the new moon over your left shoulder good luck will follow	5.77	9.19	51.0	3.3	1.9	5.2	1.6	47.7	46.1	2.7	4.9	8.6	6.3	67.8	56.1
176. To count another person's warts will cause warts to appear on you	5.73	9.90	20.9	0	.5	1.3	.8	24.2	17.7	2.7	2.0	4.3	2.9	22.5	22.9
177. If you sleep in a strange room and have someone name the corners, the first corner seen the next morning will reveal your future husband	5.41	13.51	12.1	.7	.3	1.3	.3	11.1	5.1	1.6	.5	4.8	1.5	26.7	12.2
178. Thirteen is an unlucky number	5.19	16.91	98.6	4.6	4.8	22.9	12.1	100.0	97.3	4.8	6.3	22.5	16.1	100.0	98.5
179. 179. To see the moon over the right shoulder brings good luck	4.93	9.72	77.3	4.6	2.9	7.2	4.6	69.9	79.9	2.7	5.9	8.6	12.2	75.9	79.5
180. Thirteen people at the table is bad luck	4.93	9.72	77.3	4.6	2.9	7.2	4.6	69.9	79.9	2.7	5.9	8.6	12.2	75.9	79.5
181. If a child sleeps with his textbook under his head, at night, he will know his lesson the next day	4.73	9.46	24.5	2.6	.3	2.6	1.3	35.3	25.5	3.7	1.5	6.4	4.4	48.7	37.6
182. When a child wishes to stop swinging and someone says the phrase, "Let the old cat die," it is unlucky to quicken the motion of the swing again	4.62	11.34	25.9	3.3	.8	4.6	0	34.6	10.2	1.1	.5	9.1	1.5	53.5	22.9

183.	If you break a mirror you will have seven years of bad luck..	4.55	14.54	98.1	3.3	2.9	17.6	8.8	97.4	97.9	5.9	6.8	20.9	16.1	99.5	98.0
184.	If it rains on your wedding day, it is a sign of future trouble...	4.39	7.49	42.2	1.3	1.1	3.9	1.6	32.7	39.9	2.1	3.4	5.9	2.9	49.2	46.8
185.	Some individuals called "mediums" are able to talk with the spirits of the dead	4.34	6.21	75.4	4.6	2.1	6.5	2.1	73.9	81.8	4.3	3.4	9.6	3.4	69.0	70.7
186.	When a girl dreams with a wedding cake under her pillow, the one dreamed of will be her future husband	4.21	13.68	31.0	2.0	.3	3.3	.3	24.2	22.0	1.6	2.4	11.2	5.9	48.1	37.1
187.	To kill a toad brings rain.....	3.93	4.97	41.6	.7	.5	1.3	1.3	32.7	46.4	2.1	3.9	2.7	3.4	31.0	49.3
188.	To kill a snake and hang it on a tree or fence will bring rain	3.92	5.49	27.8	2.0	.5	2.0	1.1	39.2	25.5	.5	2.0	2.1	1.5	27.8	23.4
189.	If you open an umbrella in the house it brings death to someone in the family	3.80	8.22	34.4	2.0	.3	3.3	1.1	41.2	24.4	1.6	2.4	6.4	2.4	51.9	31.7
190.	If thirteen sit down at the table together, one of the number will die before the year ends	3.48	9.06	31.5	.7	.8	3.3	1.1	32.0	26.5	2.1	1.0	7.0	2.0	46.0	25.9
191.	A horse-chestnut carried in the pocket prevents rheumatism....	3.21	5.13	17.0	1.3	.5	2.0	.5	20.3	16.6	.5	0	.5	1.0	17.1	15.1
192.	If you carry any kind of a garden tool, as for example, a spade or a hoe, through the house, it means a death in the family soon	2.75	3.67	11.9	.7	.3	.7	.3	21.6	6.4	.5	0	.5	.5	19.3	7.8
193.	A new-born babe is brought by a stork	2.71	4.32	88.3	5.2	1.3	8.5	2.9	92.8	88.5	2.1	2.4	2.7	2.9	89.3	83.9
194.	To put the left shoe on first brings bad luck	2.66	5.62	36.8	1.3	1.1	3.3	.8	49.7	31.9	1.1	.5	4.3	1.5	46.5	27.3
195.	If you enter the house by one door and leave by another, it will bring bad luck	2.51	5.96	34.7	.7	.3	2.0	.3	41.8	22.8	3.2	0	6.4	1.5	65.8	22.9
196.	If you see the new moon over your left shoulder for the first time, you will have bad luck..	2.33	8.14	28.0	1.3	.5	3.9	.8	31.4	25.2	1.1	0	6.4	0	38.5	21.5
197.	To break a mirror signifies that there will be a death in the family before the year closes..	2.31	4.62	18.8	0	.3	.7	.3	28.8	11.3	1 1	.5	2.1	1.0	31.0	14.1
198.	If you drop hairpins from your hair, it means that your beau is thinking of you	2.17	10.00	25.1	1.3	.8	3.3	.8	25.5	17.7	2.1	2.4	4.8	2.9	34.2	29.8
199.	If you carry a nutmeg in your pocket, you will not have rheumatism	2.02	2.02	16.1	.7	0	.7	.5	20.9	16.4	1.1	0	.5	0	16.0	12.2
200.	A witch can and sometimes does conceal his or her identity in the form of some animal, as a black cat, or some object or plant	2.00	2.50	65.2	2.0	1.1	3.9	.5	64.7	67.0	2.1	.5	2.7	1.0	61.5	65.9

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This is a selected list of publications made from a very large list that has been compiled. The articles here presented are grouped under *Studies*, and *Compilations and Discussions*. This division, while not to be regarded as highly exact, may help others who may wish to make investigations in this field. Also, it is not possible to include many books which contain matters of interest pertaining to superstitions.

A. *Studies*

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The Adventures of a Little Boy in Molecule Land

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Tim was feeling very tired, because you see it was the first time that the nurse had let him sit up in a chair since he had been ill. Of course, it was nice to sit up and look out of the window again, but he could not help feeling sleepy.

Just as Tim's eyes began to close in spite of himself, he heard a noise. It sounded like someone jumping up and down, but it was ever so much softer. The sound seemed to be coming from the window, and sure enough, there on the sill danced a tiny creature. As Tim looked again, he saw that it was not one tiny creature but two. There were four legs and four arms, but they seemed entangled in each other. Tim thought that the best thing that he could do would be to speak to them, so he said, "How do you do, you funny little things? How did you get here?"

"Oh, we're here and everywhere all the time, only you don't know it."

"But why don't I?" Tim asked.

"This is just a special occasion for us. Other times we are ever so much smaller than you see us now."

Just then Tim heard the scurrying of many other little feet and the window sill was soon filled with many tiny little creatures very much like the first two. They kept jumping around in circles and holding each other's hands.

"Don't you ever keep quiet," asked Tim of the first two.

"Never," they replied together.

"And are these creatures in everything?" demanded Tim.

"Yes, and you couldn't count the number in our kingdom if you counted all day and all night," they exclaimed.

"And what do you call yourselves?" asked Tim.

"We call ourselves Atoms and we belong to the Molecule kingdom."

"And where is your kingdom?" Tim asked next.

"It is everywhere, we tell you, everywhere," returned the two little creatures.

"Then, how is it that I cannot see you?" asked Tim in a puzzled tone.

"Because on other days we are so much smaller that even your daddy, who looks at things through a microscope, cannot see us."

At this the two creatures began to draw apart, and seeing this, Tim exclaimed, "Oh! You don't always stick so close together?"

One little Atom spoke up and said, "No. You see it is this way—— When I am all alone by myself I am called an Atom, but when I want to see the world I join with other Atoms and as a group we are called a Molecule. Sometimes with millions and millions of other Molecules made up as we are we become a tree. Then the tree is cut down, and made into furniture just like the desk you sit at in school or like the table in the kitchen. But as I have told you before, you can't see us because we are so small and so close together."

"If you are in everything you must be in the food I eat and the water I drink and in the air all around me," said Tim.

"Of course we are. We are in you, too!" cried the Atom. "We can make ourselves into big men or little streams of water or anything else by just changing our partners when we dance. Sometimes we dance with just one or two other Atoms and at other times we have large groups with ten, fifteen or even twenty in them."

"Are you in all my clothes, toys, and everything in the world?"

"Yes, but don't try and find us or see us because you won't be able to, because you remember we are very, very small."

Just then there was a noise outside Tim's door. The Atom looked startled and clapping his hands, he beckoned the other Atoms to follow him. They danced down the windowsill and just as the last one disappeared, the door of Tim's room opened and there stood his father.

Tim told his father all about the dream, for of course it was a dream.

"Is it all true, Daddy, that everything is made of Molecules?" finished Tim.

"Yes, Son, it is all true," said the puzzled father, for he could not understand how Tim knew so much for a little boy.

"I am so tired," sighed Tim. "Won't you put me in bed, Daddy, and perhaps I shall dream of my friends the Atoms, from the Molecule kingdom, again."

National Association for Research in Science Teaching

REPORT OF THE SECRETARY-TREASURER

The Fourth Annual meeting was held in Detroit on February 23rd and 24th, 1931. The first session met in Room A of the Masonic Temple at 9:30 A. M., February 23rd, and a program of ten papers, as given in the official program, was presented. Two of the speakers were absent, namely, Dr. George W. Hunter and Mr. George E. Nelson. Their papers were read by title only.

The program of February 24th was in the nature of a symposium, the general theme of which was, "An Integrated Program of Science Teaching for the Grades of the Elementary and Secondary Schools." All the speakers were present and the papers were given in the order in which they were listed in the official program.

The Dinner Meeting was held at the Belcrest Hotel at 6:30, Monday evening, February 23rd. Twenty-one members were present.

Immediately following the dinner, Dr. George A. Rommert of Munich, Germany, gave an address on "The Use of Microprojection Methods in Teaching Living Organisms." The lecture was illustrated by demonstrations of the use of the microprojector for showing a great variety of microscopic organisms. The two outstanding features of Dr. Rommert's address were (1) the evidence of his command of techniques for growing cultures of microorganisms, and (2) the clarity with which these organisms were shown in the screen.

Immediately following this lecture the President, Dr. Elliot R. Downing, called the members to order for the business meeting.

Report of the Secretary-Treasurer—

The minutes of the Third Annual Meeting, which was held in Atlantic City, were printed in Science Education of March, 1930. The minutes were not read, but were approved as printed.

The Financial Report:

Balance on hand February 22, 1930	$122.60	
Received dues for 1930:		
40 annual members at $5.00	200.00	
1 life member	100.00	
Total active members as of February, 1930, 41		
Resignations, February, 1931, 1		
Received dues for 1931:		
26 annual members at $5.00	130.00	
Total Receipts		$552.60
Expenditures:		
Printing of Stationery	$11.50	
Telephone to Atlantic City (Feb. 1930)	.90	
Postage	1.48	
Printing of Programs (Detroit Meeting)	15.50	
Total Expenditures		$29.38
Balance on hand February, 1931		$523.22

Dr. Chas. J. Pieper reported that pledges and cash for $3500. had been received towards taking over and operating *Science Education*.

It was regularly moved and seconded that the President appoint a member of the Association, who is not a member of the group of supporters, to be designated as Holding Member and whose duty it shall be to protect the interests of the Association in the journal and to represent the Association in conducting the business affairs of the Committee on Publications. The motion was passed unanimously. The President appointed S. Ralph Powers, Secretary-Treasurer of the Association, to serve as Holding Member.

It was regularly moved and seconded that the Secretary be in-

structed to write to Dr. George A. Rommert congratulating him on the excellence of his address and thanking him for the presentation made before the members of the Association. The motion was passed unanimously.

It was regularly moved and seconded that the Secretary be instructed to write to Dr. H. A. Webb thanking him for his telegram carrying an expression of good wishes and to express to him the regrets of the Association that he could not be with us. The motion was passed unanimously.

It was regularly moved and seconded that the Secretary be instructed to write to Dr. Otis W. Caldwell and convey to him the best wishes of the members for a speedy recovery from the illness with which he has been confined. The motion was passed unanimously.

It was regularly moved and seconded that the Secretary be instructed to prepare a form to be used by the members for recommending individuals deemed worthy of membership. The motion was passed unanimously.

The Secretary read the letter of resignation which had come from Dr. J. Drushel. His resignation was accepted. The Secretary was instructed to write to Dr. Drushel expressing regrets that he was no longer able to continue his membership in the Association.

It was moved and seconded that membership in the Association shall be considered to have lapsed after a member has become delinquent for one year in payment of dues. This with a provision that the member has been duly notified. The motion was passed unanimously.

It was regularly moved and seconded that the President appoint a committee of three to study the problems of teacher training in science for teachers in the grades of the elementary school, junior high school, senior high school, and institutions for the education of teachers, including the work of graduate schools of education. The motion was passed unanimously.

From the discussion it developed that there was a general interest in problems associated with the education of teachers and there was an expression, rather general, favoring the inclusion in the program of 1932 of a symposium dealing with this topic. It was also suggested that questions indicating the scope of the symposium be gathered and printed in the official program.

The Committee on Nominations appointed by the President, consisting of Harry A. Cunningham (Chairman), Florence G. Billig, and W. F. Roecker, reported nominations of the officers and Executive Committee. The report of the committee was accepted and the officers and Executive Committee consisting of Elliot R. Downing, Francis D. Curtis, S. Ralph Powers, Ralph K. Watkins, and W. L. Eikenberry were declared unanimously elected.

S. RALPH POWERS
Secretary-Treasurer N. A. R. S. T.

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Our Plant Friends and Foes—1930—William Atherton Dupuy—277 pages—The John C. Winston Company, Philadelphia, Penn.

Dr. William Atherton DuPuy has added a new book, *Our Plant Friends and Foes*, to the Romance of Science Series. In this volume many facts concerning plants are presented in non-technical everyday language in such a way that the book is interesting, stimulating, and instructive to the lay reader. To insure accuracy in statements, specialists in scientific bureaus of the Federal Government reviewed the manuscript. Dr. William A. Taylor, chief of the Bureau of Plant Industry, the United States Department of Agriculture, wrote the introduction.

The book is composed of twenty-five chapters each dealing with important and well-known plant groups that are represented by the following: apple, cherry, bean, potato, daisy, wheat, corn, sugar cane, grape, sumac, poison ivy, watermelon, cucumber, gourd, lily, onion, garlic, orange, grapefruit, mushroom, cabbage, cotton, cactus, banana, palm, pine, oak, elm, maple, and rubber tree. In the discussion of each topic the author has emphasized factors, such as historical relationships, distribution, friends, enemies and their control, factors contributing to the success of the plant, economic importance, and the contributions of research in improving plants. The book is well illustrated by eighty-nine photographs supplied by the United States Department of Agriculture. Four of these photographs are in color. In addition, many drawings and diagrams illustrate points in the text.

The author states that the book is written "for the normal and wholesome intelligence of the fourteen-year-old boy; for the casual perusal of the young woman who grows flowers in her garden and goes tramping through the woods; and as fireside reading for the elderly couple who find keen enjoyment in reading." The clear straightforward presentation of information relating to many of our common plants, makes the book a valuable addition to the scientific literature for boys and girls of junior high school age.—FLORENCE G. BILLIG.

Essentials of Biology—1931—W. H. D. Meier and Lois Meier—529 pages—332 illustrations—$1.68—Ginn & Co.

Essentials of Biology appears to be a book for high school students or as an introductory course in college or teacher training institution by those who did not take biology in high school. It is well organized into ten related units as follows: the interdependence of living things; the transformation of inorganic matter into organic substances; the relation of animal organisms to their environment; green plants as food-manufacturing organisms; classification of plants and their relation to their environment; classification of animals and their relation to their environment; the application of biologic principles to the human body; health activities; economic biology; improvement of plants and animal life. In general it

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covers much the same ground as most high school texts, but with rather greater emphasis upon classification. The practical applications of biology to everyday life are well taken care of. There are many things in the book that make it especially helpful to one training for teaching nature study. Each chapter is followed with a vocabulary list of new scientific words used in the chapter; then there are questions for study and discussion, and a short list of problems which suggest work which may be done for extra credit. At the end of the book is a glossary of "fundamental terms in biology." It is a book that will interest you.

Modern Chemistry—1931—Charles E. Dull—776 pages—390 illustrations—Henry Holt & Co.

The author, in his endeavor to make "this book practical without neglecting the fundamental principles upon which the science is based," has, in our opinion, succeeded remarkably well. Interest is added by bringing in short accounts of the struggles of the pioneers in chemical thought. The modern election theory is treated, but the older conceptions of valence are retained. A helpful vocabularly is given at the beginning of each chapter; and at the end of each chapter are found, a summary, a list of questions and several problems. The book covers fully the outlines of the College Entrance Board and N. Y. Regents.

Matter and Radiation — 1930 — John Buckingham — 144 pages — 25 illustration—$3.00—Oxford University Press.

This book discusses in an interesting manner both old and new theories of radiation. Particular attention is given to the treatment of the infra-red group; for example, photography of invisible objects by infra-red rays is explained. The five chapters are: I. Electric waves; II. Atoms and molecules; III. The electrical structure of atoms and the production of radiation; IV. Detection of infra-red rays; V. Uses of infra-red rays.

Instructional Tests in Biology—1929—J. G. Blaisdell—56 pages—World Book Company.

There are 25 tests designed for the teacher's use in testing pupils in the fundamentals of biology at intervals throughout the course. Each test covers a single topic. They offer an excellent means of finding out when students have mastered one topic and are ready to go to the next.

Adventures in Biophysics—1931—A. V. Hill—162 pages—$3.00—University of Pennsylvania Press.

This account of research and of the carrying out of research is unusual in the entertaining literary style in which matter of fact data are given. Some interesting results of the difficult researches are noted. The five lectures cover these subjects: Some adventures with vapour pressure; the state of water in tissues; the conception of the steady state; the time-relations of events in muscular contraction and other matters.

Wiedefeld-Walther Geography Test — 1931 — M. Theresa Wiedefeld and E. Curt Walther—2 Forms, A and B—World Book Company.

These tests are designed to take an inventory of the pupils' achievement in grades 4 to 8. Each form comprises 6 tests. I. Reading ability. II. Organization ability. III. Map and graph reading ability. IV. Vocabulary. V. Geographical relations. VI. Locational geography.

Engle-Stenquist Home Economics Test—1931—Edna M. Engle and John L. Stenquist — Three different tests: Foods and Cookery, Clothing and Textiles, Household Management—Each test is sold in packages of 25 with Manual of Directions, Key, and Class Record—Per package $1.00—World Book Company.

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There are two forms, A and B, of each of the three different tests in this series, which, used together, yield an objective measure of students' knowledge of broader phases of home economics. The tests cover principles underlying certain skills in foods, clothing, and household management.

Presson Biology Test—1931—J. M. Presson and L. A. King—Two tests—$1.20 per package of 25—World Book Company.

The *Presson Biology Test* consists of two separate achievement tests, Test 1 covering plant biology, and Test 2 dealing with animal and human biology. Each is to be given at the end of one semester to students who have covered at subject matter of the test at high school level. There are two forms of each test.

Living in a World of Science—Morris Meister—Charles Scribner's Sons.

I *Water and Air*—1930—238 pages—162 illustrations.
II *Heat and Health*—1931—236 pages—164 illustrations.
III *Magnetism and Electricity*—1930—210 pages—149 illustrations.
IV *Energy and Power*—1930—238 pages—175 illustrations.

These four books provide material for General Science in two years of the junior high school. Books I and II are suggested for the seventh grade and Books III and IV for the eighth grade. The material selected is well adapted to the grade levels. Each book is a collection of sixteen units, which is about the amount that can be easily covered in half a year. There are a number of teaching aids as, test questions, things to read about and think about, and things to do and make. The style of writing makes an unusual appeal to the pupils of junior high school age. The illustrations show much originality and suggest many things that the pupils will wish to make and try out.

There has been some complaint from school men about the dearth of science books adapted to the junior high school, but with this set of books added to the Carpenter and Wood series already in the field, lack of suitable texts can no longer be accepted as a reason for keeping general science out of the junior high school.

Chemistry and the Home—Howe and Turner—Charles Scribner's Sons—355 pages—1927.

This is not a book for use as a text in home economics classes, but it is a valuable supplementary book for chemistry or for general science classes. It contains interesting and valuable subject matter upon the following topics: chemistry everywhere, chemistry in foods and nutrition, metals in the kitchen, glass, science in cleanliness, fabrics, paper, ink and pencils, rubber, protective coatings, photographs, perfumes, drugs, illumination, leather, fuels, and chemistry in the garden.

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Many manufacturers prepare materials for school exhibits and classroom use and send this material free. In some cases the practice is continued year after year; in other cases when the sets prepared are exhausted the matter is dropped. The practice is dropped by some who find it a very expensive form of advertising. Two hundred and twenty-five circular letters were sent out to those listed as sending free material, in three different printed lists.[1] The following reply that they have discontinued sending free material.

1. Hecker-Jones-Jewell Milling Company, Minneapolis, Minnesota.
   Out of Hecker Education Exhibit. Will send an interesting booklet entitled "Adventures of a Kernel of Wheat."
2. Larkin Company, Inc., Philadelphia, Pa.
   Discontinued Soap-making Exhibits.
3. Kirkman & Son, Inc., Brooklyn, New York.
   Discontinued display materials.
4. Russell-Miller Milling Co., Minneapolis, Minnesota.
   Wheat and Flour Exhibits will be ready for distribution in the Fall.
5. Bakelite Corporation, 247 Park Avenue, New York.
   Policy of sending out display exhibits has been discontinued.
6. Smithsonian Institute, U. S. National Museum, Washington, D. C.
   No material available.
7. Tubize Chatillon Corporation, 2 Park Avenue, New York City.
   Supply is exhausted.
8. Long-Bell Lumber Sales Corporation, Kansas City, Mo.
   No models, samples, or exhibits available.
9. Sheffield Farms Company, Inc., 524-528 West 57th Street, New York City.
   Distribution of materials limited to Metropolitan New York.
10. New Jersey Public Utility Information Committee, 313 Market Street, Camden, N. J.
    Nothing available for distribution.
11. Pfister & Vogel Leather Company, Milwaukee, Wisc.
    Discontinued sending samples and literature.
12. Stackpole Carbon Company, St. Marys, Pennsylvania.
    Brush Exhibit Boards exhausted.
13. Aluminum Company of America, Pittsburgh, Pa.
    Supply of exhibits is exhausted.
14. Baldwin Locomotive Works, Philadelphia, Pa.
    Nothing for distribution.
15. Beech Nut Packing Company, Canajoharie, New York.
    Discontinued sending exhibits.
16. Hampshire Paper Company, South Hadley Falls, Mass.
    Nothing available.
17. Amoskeag Manufacturing Co., Manchester, New Hampshire.
    Discontinued distribution of educational material.
18. Fansteel Products Co., North Chicago, Illinois.
    No exhibits of rare metals for exhibits.
19. Duriron Company, Dayton, Ohio.
    No school exhibits.

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1 These lists are those in "Enriched Teaching of Science in High Schools," 1928, Woodring-Oakes-Brown; "Illustrative Material," 1927, Griffith and Lott; and "Sources of Free Material for Science Instruction," Ralph E. Dunbar," in General Science Quarterly, May, 1928.

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